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MAINTENANCE ENGINEERING

IN PLANTS, MILLS, AND FACTORIES

FORMERLY 'INDUSTRIAL ENGINEERING'

Recommended: Courage, Not Sentiment

The need for modernization is just as imperative as ever, in spite of depression. Altruistic motives, inducing reluctant installation of equipment that will throw men out of work, are natural to employers who are happy when all is well with their fellow men. Of this type of employer the bulk of our industrialists is comprised. When they close their doors to modernization on such grounds they are acting in accord with sentiment.

But what of their duty? Do they owe more to the relatively small group that would become unemployed because of the introduction of modern equipment than they owe to the manpower of their plants as a whole? Are they justified in refusing to increase competitive ability through failure to lower unit production cost? If they are, there is justification in setting about deliberately to undo the progress already made in transferring burdens from humans to machines.

Equipment salesmen are meeting this "do-not-want-to-add-to-unemployment" resistance. Well-meant, it is nevertheless a retarding influence so far as a general return to prosperity is concerned. Attitudes must be changed, courage substituted for sentiment, policies for the "long haul" adopted, equipment and plant modernized.

This changed outlook on the part of management is sound; it must be supported by every plant-operating man. It is the responsibility of each man in the plant-operating group to strengthen his own plant's competitive position from a net-profit standpoint. His objective will be to maintain the ability of his plant to give continuous and profitable employment without sacrifice of stability. Modernization of plant and equipment is his strongest tool.

A McGraw-Hill Publication

25 cents per copy

JULY 1931

Announcing

TEXSTEEL SHEAVES

for Texrope Drives

Allis-Chalmers announces a large stock of TEXSTEEL Sheaves for Texrope Drives to meet the increasing demand for a lower-priced unit. This is particularly important where a V-belt drive is to be used as standard equipment on machinery for resale.

The new TEXSTEEL Sheaves are formed of extremely tough steel . . . are almost indestructible . . . and will perform to the satisfaction of the most discriminating user.

Each section of TEXSTEEL Sheaves is welded, both at the web and at the rim . . . eliminating all vibration and noise . . . giving an accurate balance, and a true running quality otherwise difficult to obtain.

TEXSTEEL Drives are light in weight and easily installed. A high grade aluminum paint is used on TEXSTEEL Sheaves for appearance and protection. This adds materially to the attractiveness of the manufactured product.

Complete TEXSTEEL Texrope Drives are now available from stock for immediate delivery. Prices and information may be obtained from the nearest Allis-Chalmers office . . . or from the factory at Milwaukee.

ALLIS-CHALMERS MANUFACTURING CO., *(Texrope Division)*
Milwaukee *Specialists in Power Machinery Since 1846* Wisconsin

Atlanta, Ga., Baltimore, Md., Birmingham, Ala., Boston, Mass., Buffalo, N. Y., Charlotte, N. C., Chattanooga, Tenn., Chicago, Ill., Cincinnati, Ohio, Cleveland, Ohio, Dallas, Texas, Denver, Colo., Detroit, Mich., Duluth, Minn., El Paso, Texas, Grand Rapids, Mich., Houston, Texas, Indianapolis, Ind., Jackson, Mich., Kansas City, Mo., Los Angeles, Calif., Milwaukee, Wis., Minneapolis, Minn., New Haven, Conn., New Orleans, La., New York, N. Y., Philadelphia, Pa., Phoenix, Ariz., Pittsburgh, Pa., Portland, Ore., Richmond, Va., St. Louis, Mo., Salt Lake City, Utah, San Antonio, Texas, San Francisco, Calif., Seattle, Wash., Shreveport, La., Spokane, Wash., Tampa, Fla., Toledo, Ohio, Tulsa, Okla., Wilkes-Barre, Pa.

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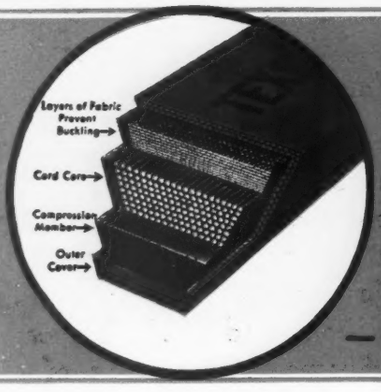
ORIGINATED BY ALLIS-CHALMERS
TEXROPE DRIVES
THE DRIVES THAT REVOLUTIONIZED TRANSMISSION PRACTICE • • •



The accuracy with which the belts fit the grooved sheaves has a decided effect upon the drive. Texrope Belts, made for Allis-Chalmers by Goodrich, are formed in precisely machined molds. They seat perfectly in the grooves of Texrope Sheaves.

Thoroughly in keeping with the new TEXSTEEL Sheaves are the latest Texrope Belts, here shown . . . possessing amazing ability to give long service under the constant flexing to which they are subjected. Well over 600,000 Texrope Belts are now in service . . . perfected for Allis-Chalmers or

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MAINTENANCE ENGINEERING

A McGraw-Hill Publication, founded 1882

JULY, 1931

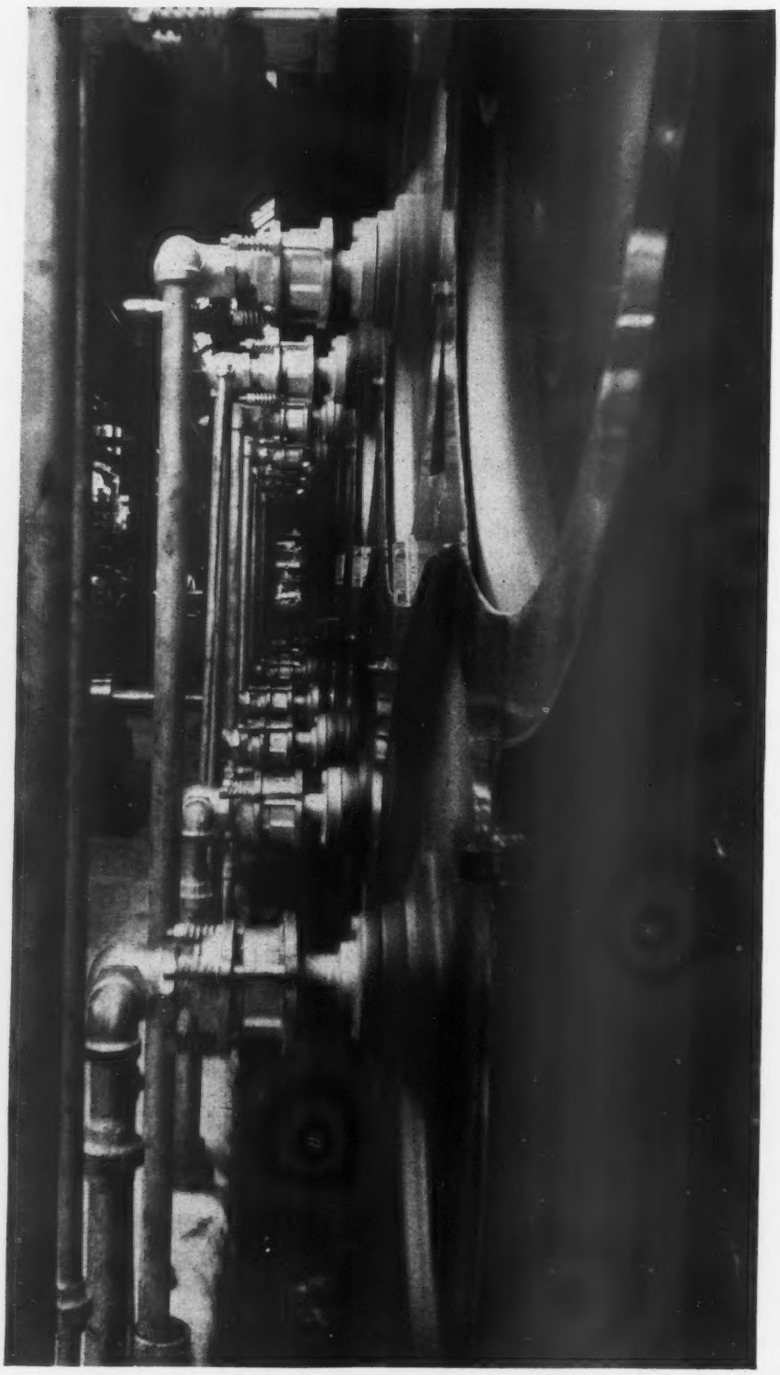
MODERNIZATION is the theme of this issue of "Maintenance Engineering." There are three classifications under which the theme is treated: Equipment Modernization; Methods Modernization; Wage-Payment Modernization.

In the modernization of equipment lie the greatest opportunities for maintenance engineering at this time. Therefore most of the issue shows what modern equipment is doing. Under the classification "Equipment Modernization" is, first, the opening article, eight pages long, which gives an insight into the actualities of equipment modernization in an outstanding paper mill; and, second, thirty pages of illustrations showing modern equipment at work in plants of many industries.

Under the classification "Methods Modernization" is an actual experience article that tells of the savings achieved by conscientious, concerted attack upon indirect expenses —the kind with which maintenance departments have most to do.

The first of a series of three articles showing how a wage-incentive plan for maintenance work is being applied successfully in a large steel mill constitutes the treatment of the third classification, "Wage-Payment Modernization."

With these three classifications of modernization each man connected with the function of maintenance is concerned. Upon the extent of his knowledge concerning them will depend his ability to cooperate in modernizing plant and equipment in either creative or supporting capacity.



It has been the policy of this company in times of general depression to concentrate our efforts in the direction of improving our manufacturing facilities. — W. D. RANDALL, Vice-President and Mill Manager

EQUIPMENT A

ITS history shows that our company always has secured the advantages to be obtained by the use of modern equipment. It has followed the policy stated by W. D. Randall, Vice-President and Mill Manager, and quoted in display type on this page.

Organized at Hamilton, Ohio, in 1894, The Champion Coated Paper Company erected a small mill for coating paper only, the paper being purchased from other mills. The first paper-making machinery was installed in 1902. Additional installations have increased the number of paper machines to eleven, with a daily output of 800,000 pounds. The Fibre Division, at Canton, N. C., produces both pulp and paper.

Obviously only a limited number of our modernization activities can be told about in a single article. Those that I shall describe constitute some of the recent changes and additions that have been made at the Hamilton plant with the objectives of increasing production, cutting costs, bettering quality, eliminating noise, increasing safety.

The drives for a paper-making machine and its auxiliary equipment are classified into two distinct groups, (1) sections of the paper machine proper, operated at variable speed, and (2) stuff chest agitators, stuff pumps, screens, Jordans, vacuum pumps, and similar equipment, operated at constant speed.

Power was furnished to each part of group 1 by means of a variable-speed twin engine and a long lineshaft. The lineshaft still is used, but the source of power is a 220-hp. variable-speed motor, each motor having its own motor-generator set and pilot generator driven from the lineshaft, as illustrated by Fig 1. The

T MODERNIZATION

C. L. McKASSON
Assistant Works Engineer, The Champion Coated Paper Company
Hamilton, Ohio

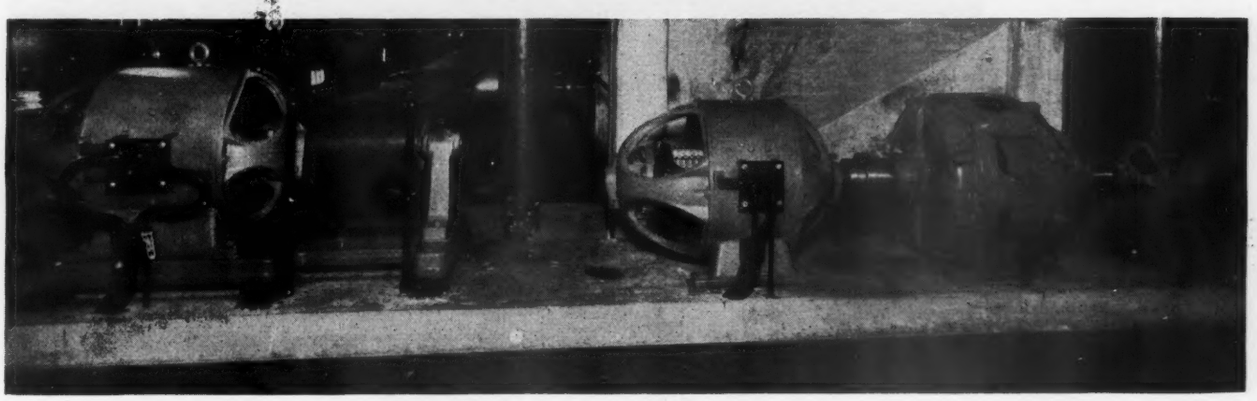
machine speed must be kept absolutely constant, at any selected paper speed from 150 to 500 ft. per minute.

The speed at which a paper machine is operated is governed by the type and weight of the paper being made. When a machine is changed from one type or weight of paper to another it may be necessary to change the speed of the machine. When the machines were driven by steam engines, it was necessary for the man in charge of the machine crew to leave his machine, go to the basement, and request the engineer to slow down or speed up his engine. With the electric drive the change in speed is made by the machine tender himself by means of a simple electrical control operated through push-buttons. See Fig. 2. Indicating and recording speed indicators insure the required accuracy.

Formerly the constant-speed group of equipment (referred to previously as group 2) was driven by a single Corliss engine and a long lineshaft. Most of the equip-

Fig. 2—Paper machine control desk, serving two machines. Speed indicator shows machine speed in ft. per min. Another instrument records paper speed, times when changes are made, paper breaks, time when machine is down. Start and stop buttons provide instant remote control. Constant-pressure speed-change buttons provide remote control of motor-operated rheostats. Weight of paper being made is determined by use of the paper scales.

Fig. 1—Motor of 220 hp. driving variable-speed shaft of paper machine (left), and motor-generator set with pilot generator (right). Speed change is under control of the machine tender by means of remote control buttons.



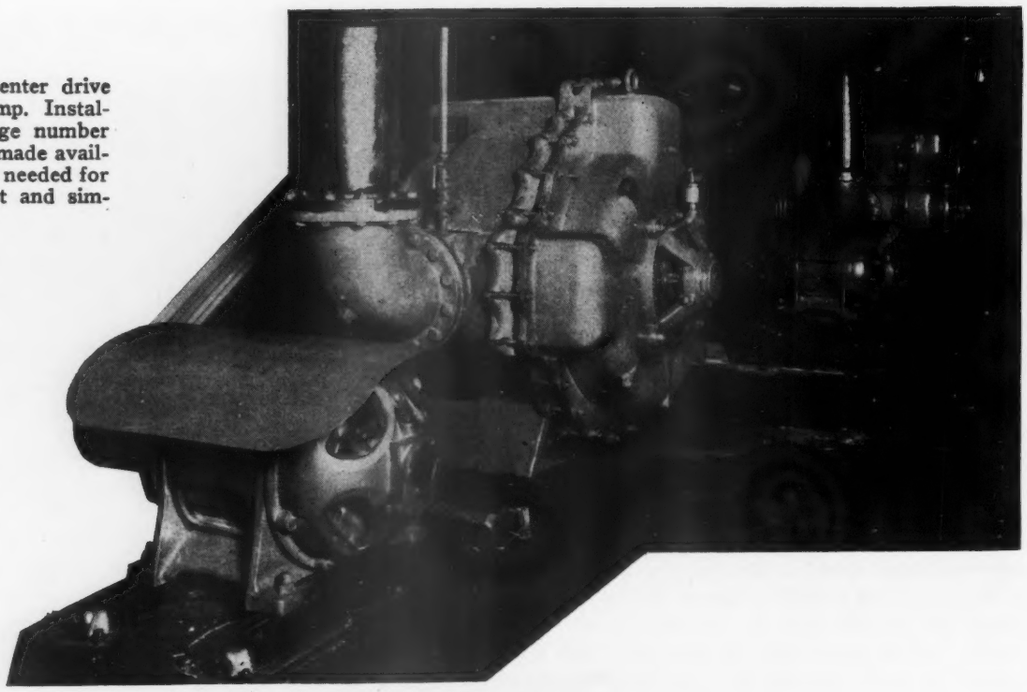


Fig. 3—Short-center drive for vacuum pump. Installation of a large number of these drives made available floor space needed for other equipment and simplified piping.

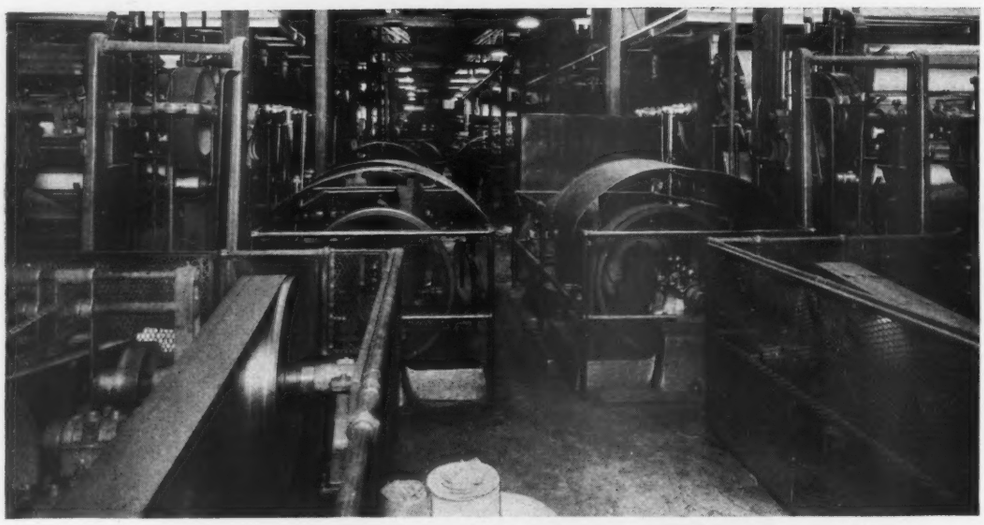


Fig. 4—Drive sections of two machines before old bevel mortise gear drives were removed.

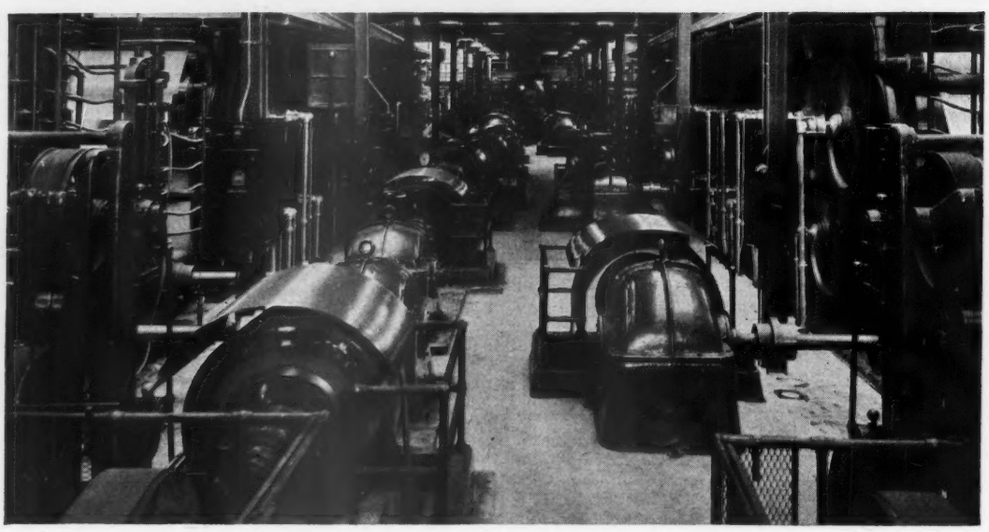


Fig. 5—Same as Fig. 4, after installation of Hypoid drives.

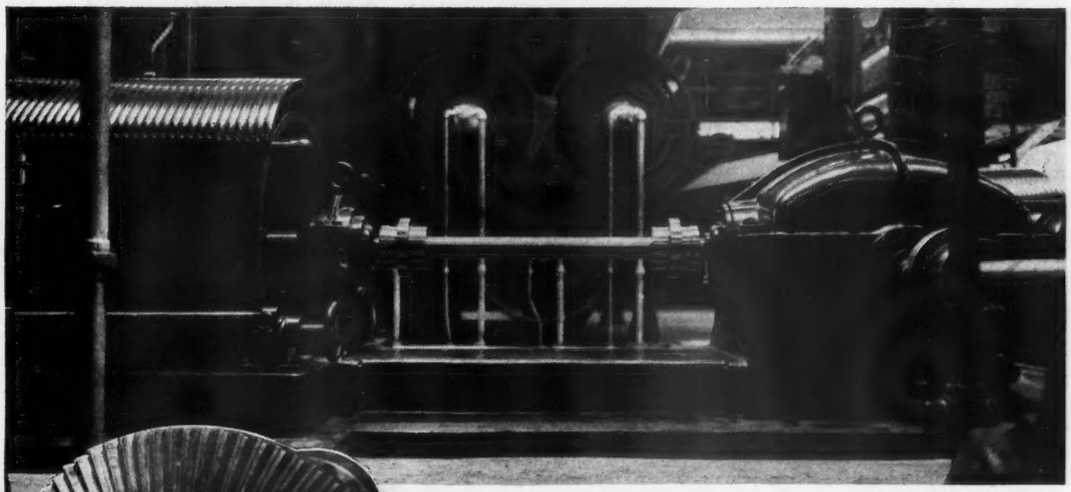


Fig. 7—Hypoid-gear drive-stand, showing that the distance from center of slow-speed shaft to center of pulley may be any length desired. Note flexible couplings.

Fig. 6—The Hypoid gear with case cover removed. Off-center gears permit bearings on both ends of pinion shaft.

ment in this group has been equipped with individual motor drives, leaving only the stuff chest agitators and stuff pumps to be driven by the lineshaft, with a small motor as the source of power. Because the machines are in a close group the shaft is very much shorter than formerly, and at least 60 per cent of the bearings have been eliminated.

After equipping the Jordans, vacuum pumps, screens, and tray pumps with individual motors, it was no longer necessary to locate them where they could be driven from the lineshaft, and they were relocated to simplify their piping, to increase convenience in operation and maintenance, to conserve floor space, and to reduce hazard.

Perhaps the best example of what was done with a single type of equipment is illustrated by the vacuum pump drives, Fig. 3. The close-center drive shown has replaced the former drive, which had a 15-ft. center distance. The motor delivers 40 hp. at 870 r.p.m. Since this drive was installed by us it has been adopted as standard equipment by the manufacturer of the pump.

Each paper machine requires three pumps of this type. Under one group of five machines we have 15 pumps installed in three straight rows, each pump directly under that part of the machine which it serves, thus requiring the shortest pipe connections. With the old lineshaft arrangement, the pumps necessarily were scattered all over the basement, with a maze of piping running in every direction.

Electrification, relocation of equipment, and elimination of the bulky steam engines have released much valuable space for the installation of machinery recently introduced to the industry. New methods and the equipment that their use requires are becoming very desirable, in some cases absolutely necessary, to the paper manu-

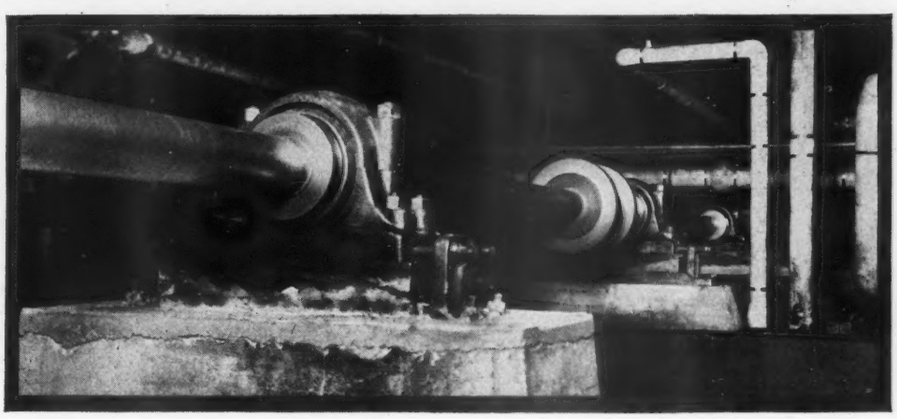


Fig 8—Section of a variable-speed lineshaft equipped with tapered-roller bearings.

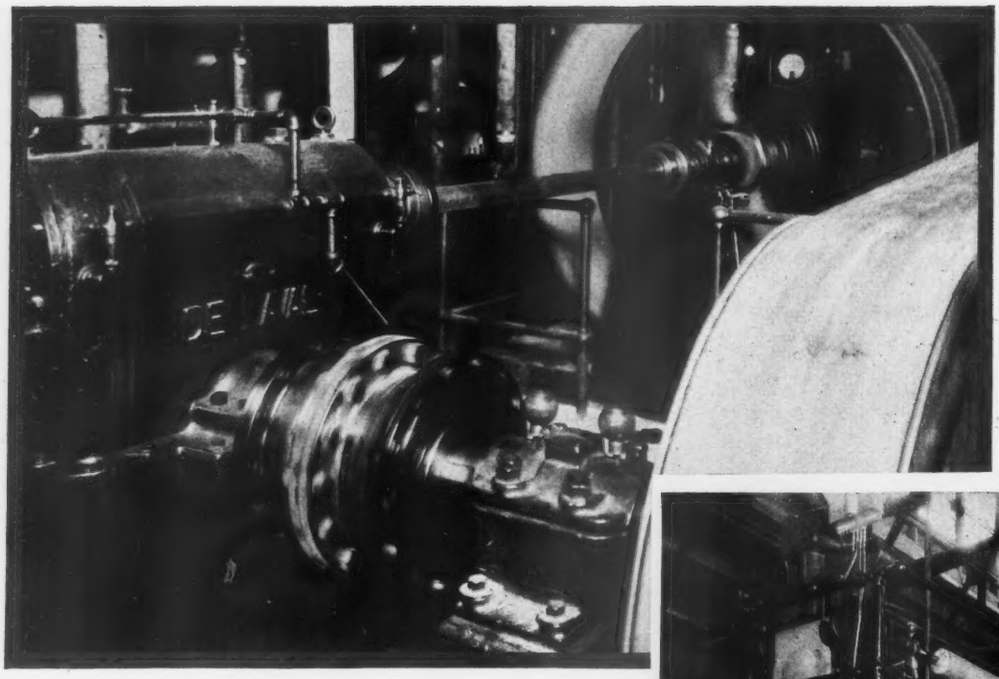


Fig. 9—Worm-gear drive on wet end of cardboard machine. High-speed shaft is connected to cone pulley by flexible coupling and floating shaft. Low-speed shaft is connected to final drive by large flexible coupling. The final drive is a leather-link friction belt, designed to permit limited slip, a technical requirement.

facturer who hopes to keep or set the pace in his industry. Several months ago this company installed a battery of Erkensators—machines for removing by centrifugal force the small dirt particles which could get through the finest screens and show up in the paper. These machines were the first installed in this country on sulphite bond paper. They take up a lot of room that would not have been available before motorizing our constant-speed equipment.

On each of our paper machines proper there are six or more sections, each driven through an independent geared speed reducer, power for which is obtained from the variable-speed lineshaft in the basement, being transmitted by means of belts and cone pulleys, the cone pulleys being necessary to obtain very fine speed adjustment. Originally the machines were equipped with what were known as compound drives, a combination spur and bevel gear affair with babbitt bearings and open gearing.

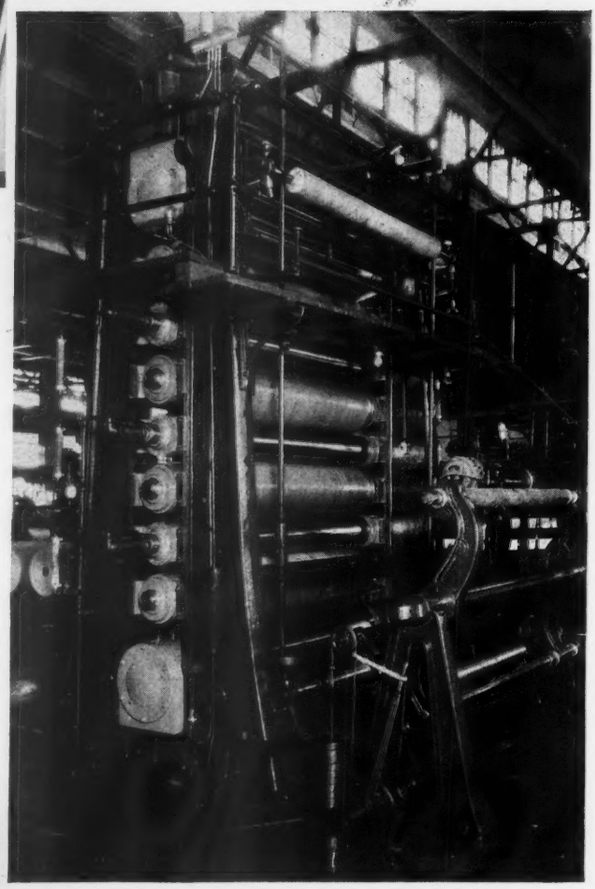


Fig. 10—The first super-calender stack completely equipped with Timken bearings.

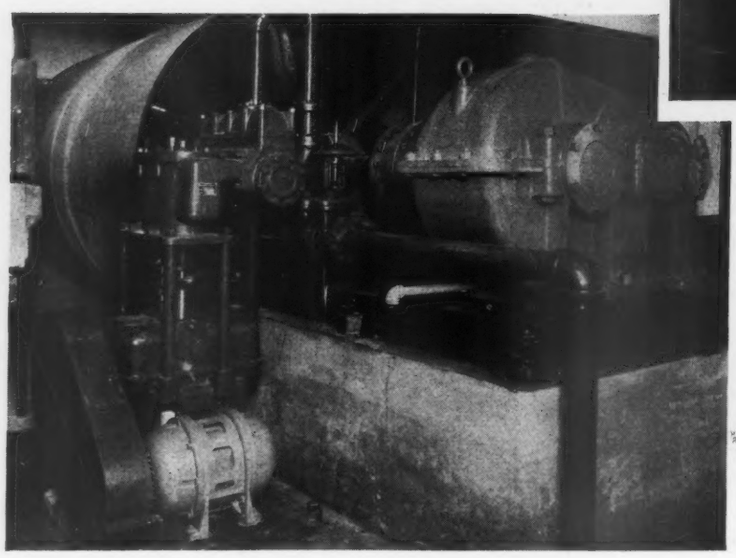


Fig. 11—All electric-welded, tapered-roller bearing ball mill, for grinding color. The drum is 10 ft. long and 7 ft. 6 in. in diameter. Mill is driven by speed reducer. The vertical piston pump circulates color to third-floor color room and returns it to a pit under the mill.

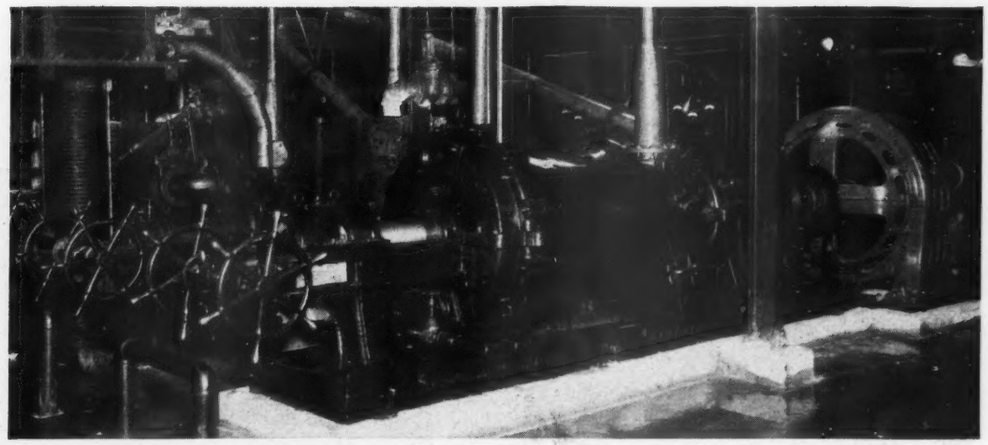


Fig. 12—Very large Jordan, tapered-roller bearing equipped, and driven by direct-connected, 450-hp., 400-r.p.m. synchronous motor.

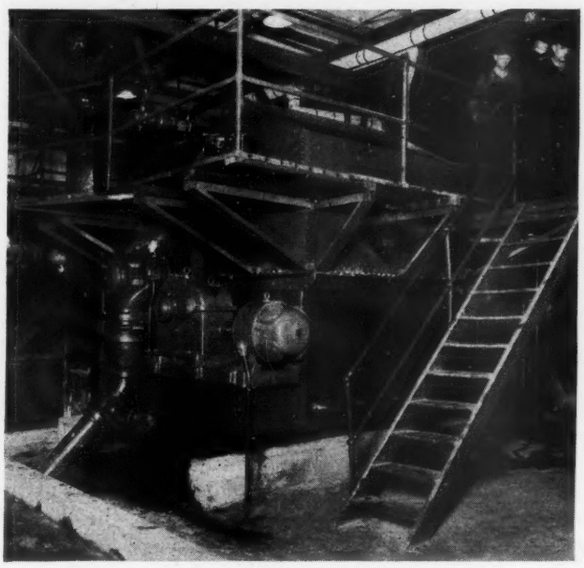


Fig. 13—Continuous vacuum filter for reclaiming fiber and clay and clarifying water; 7,000 gal. of water per minute now being filtered.

In 1921 machine speeds were increased. The compound drives were found to be inadequate for the new duty, so they were replaced by quill drives with better bearings and single bevel gear reduction composed of a steel pinion and a large, wood-tooth, mortise bevel gear, Fig. 4. They were the last word, but since that time speeds have been creeping upward and these drives now are being replaced by the type of gear drive shown in Fig. 5. The drives are fully inclosed, run in oil, and are equipped with tapered-roller bearings throughout. They are absolutely quiet. The manually operated friction clutches, used on the older type of drive, are replaced on this type by magnetic clutches operated by pushbuttons from the front side of the paper machine.

The drives on the first machine so equipped in our mill have spiral bevel gears. When layouts for other machines were made, difficulties were encountered, on account of the smaller size of the new drive, especially the lesser distance from the center of the slow-speed shaft to the center of the cone pulley. To have installed the close-coupled drive would have necessitated placing lineshaft pulleys where bearings and shaft couplings had to be, and placing belts where floor beams already were. All of this meant that the old dimension had to be retained and the drive designed accordingly. The hypoid gear, Fig. 6, was the answer. As shown in Fig. 7, it permitted bearings on both ends of the high-speed shaft, a flexible coupling between the shaft and the pulley shaft, and a pulley placed at any desired distance from the gear.

The average dryer section of our machines consists of 26 dryer rolls 48 in. in diameter. A section is driven from a drive stand geared to one of the dryer gears, and all of the rolls are geared together by means of gears

Fig. 14—Modern lighting system in inspection department of finishing room, where each sheet of paper is inspected on both sides. Light must be good, but free from glare.

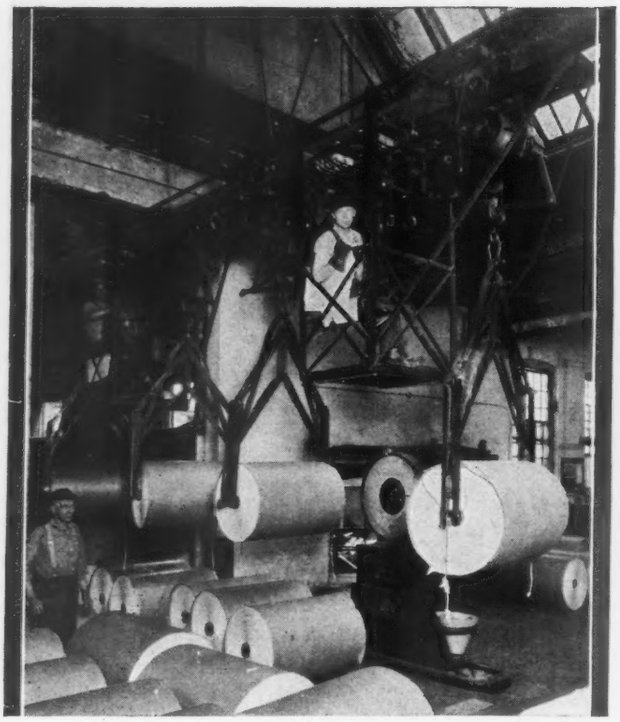


Fig. 15—Single-rail crane system for transporting rolls of paper from the machine room to the two roll-storage rooms. Rolls are taken directly from the finish-ends of machines.

Fig. 16—Note the height to which rolls can be piled, and the small space required for operating the safety roll tongs.

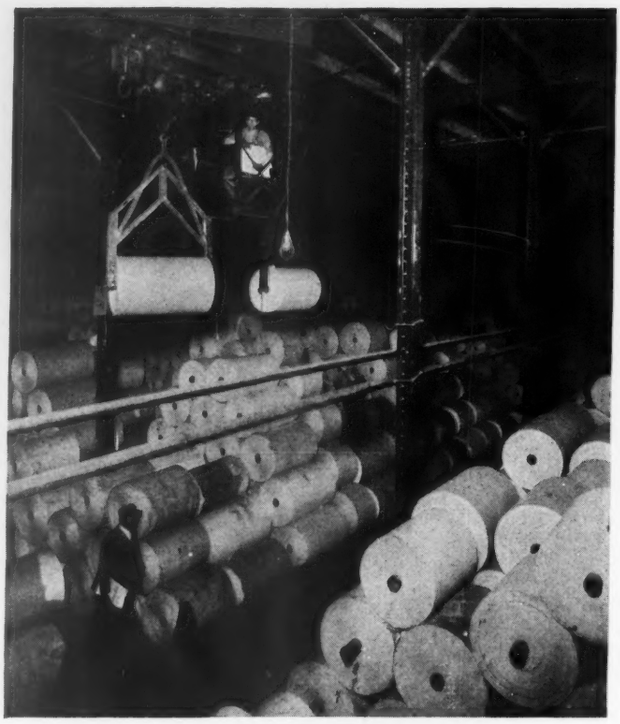


Fig. 17—Tapered-roller adapter-type, felt roll bearing (lower), shown in contrast to plain bearing (upper). The rolls must be removed and replaced without the use of tools.

60 in. in diameter. All of the old gears are being replaced by gears with the Maag tooth, to obtain smoother operation with less maintenance cost. The headpiece illustration shows driers with the new gears.

On two of our machines the variable-speed lineshafts, as shown by Fig. 8, have been equipped with tapered-roller bearings.

The old drives on the cardboard machine has been replaced by worm gear drives, Fig. 9, a change that has eliminated very costly maintenance. Moreover, it has eliminated the corrugating of rubber rolls that took place as a result of tooth chatter, existing in the former drive.

Another item to which much attention has been given is bearings. Hundreds of plain bearings on the paper machines have been replaced by roller bearings with wonderful success. We do not believe that anti-friction bearings should replace all plain bearings; there are places where anti-friction bearings should not be used. But we do believe that much of the grief experienced with anti-friction bearings has been caused by the method of installation rather than by the type of machinery with which they were used. Machines that were considered in other plants as offering service too severe for anti-friction bearings have been equipped with roller bearings in our plant and have given entirely satisfactory service. Similar equipment without them would not be considered now. The most recent installation is a super-calender stack, Fig. 10, with all rolls (top, bottom, and intermediate) carried in tapered-roller bearings. It is the first completely Timken equipped stack.

An installation of six large pebble mills, one of which, with its drive, in shown in Fig. 11, is another example of equipment with anti-friction bearings. Each end of the drum is equipped with a tapered-roller bearing of 10¼-in. bore, and each bearing carries 35,000 pounds. The horsepower required is much less than that required for a mill of the same size and capacity mounted on plain bearings, the starting current and shock on the line cannot be compared, and no bearing-cooling water is necessary.

Still another example is found in a group of Jordan engines installed recently—the largest ever built by the Noble & Wood Company. See Fig. 12. They are equipped with tapered-roller bearings, as are most of the remaining 34 Jordans in the plant. Twenty-nine of these Jordans are direct-connected to synchronous motors varying from 90 to 450 hp. at 400 r.p.m. The remainder are direct-connected to induction motors. The synchronous motors

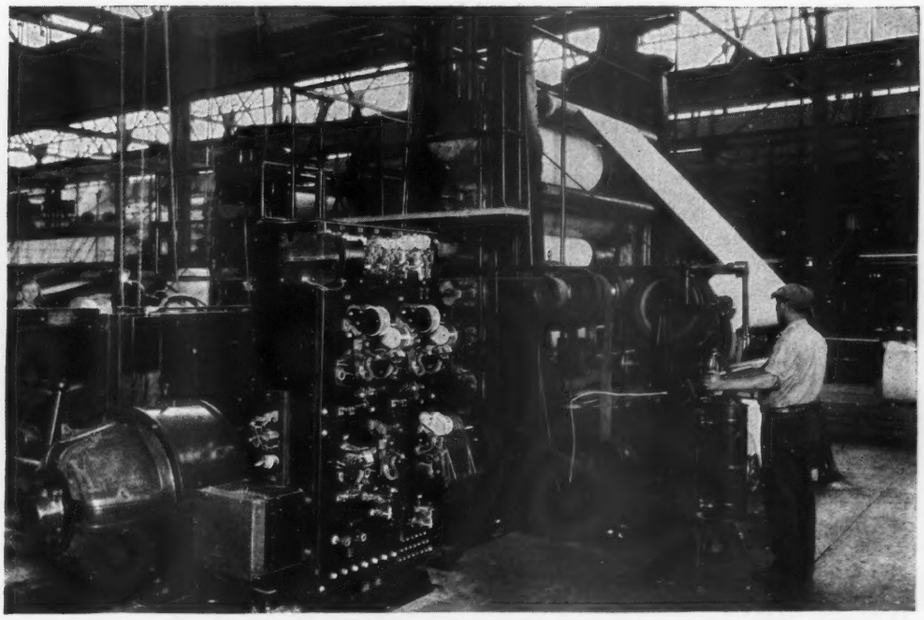


Fig. 18—Direct-connected, motor-driven super-calender stack with three-voltage speed control. Three d.c. voltages are generated, 20 volts for threading, 120 and 250 volts for operating. While operating at threading speed the stack can be started and stopped (and inched, or jogged) from any one of three sets of pushbuttons, conveniently located, but operating speeds can be obtained and controlled only by means of the drum controller at the front of the machine. An ammeter, by indicating unusual loads, tells of bearing trouble or too-high roll pressure.

make power factor correction extremely simple as compared with the condition existing a few years ago.

A short time ago there was made a study of the loss of fiber and clay which found its way from the mill into the river. It was found that the equipment being used to prevent such loss could be replaced profitably by more modern equipment. Large vacuum filters, Fig. 13, were installed, and at present 7,000 gal. of water per minute are being filtered and the material saved. These filters also have contributed their bit toward the prevention of stream pollution.

Many other examples of equipment modernization are available, but limited space makes it possible to show only a few of them. They are illustrated in Figs. 14 to 19, inclusive. I must rely upon the captions to furnish the text.

Now a word about the facilities at the disposal of the men responsible for designing, planning, building, and maintaining the plant and equipment. There is a complete engineering department, wherein every contemplated change is studied and layouts are made. If suitable standard equipment cannot be found, we must design our own.

Not only the designing, but the building, can be done in our own plant. The machine shop is large enough, and is equipped with machine tools of sizes and varieties to take care of any emergency.

Our electrical department takes care of all maintenance of electrical equipment, including the rewinding, as necessary, of the 2,700 motors that are in use throughout the plant. All installations of electrical equipment also are handled by the men in this department.

I began the article by quoting one of our executives. The best closure that I can think of is a statement made by another of our executives, Alexander Thompson, Vice-President and Manager of Sales: "Many concerns operate their plants as though they were static and would continue to run without attention, but that is not true. A plant may be likened to the human body that will only perform properly so long as it is kept in the best condition."

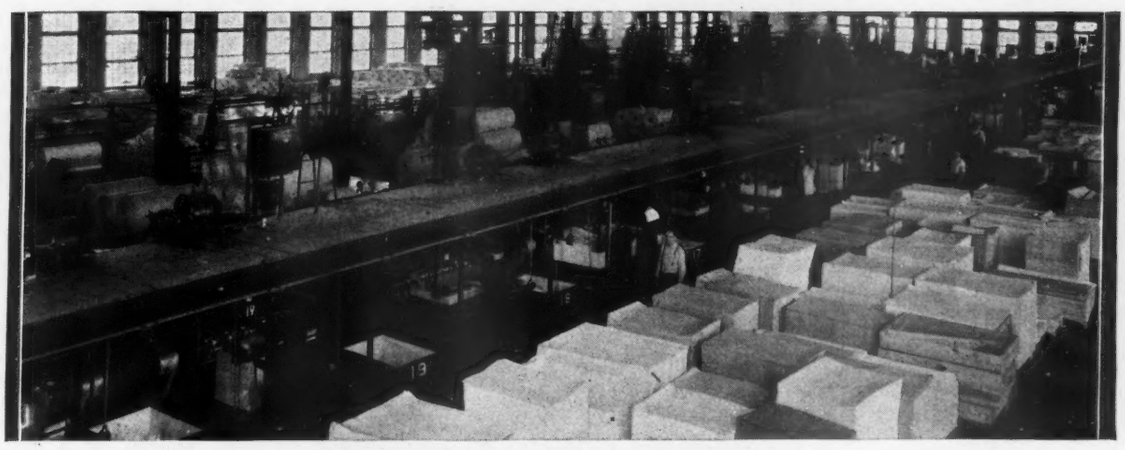
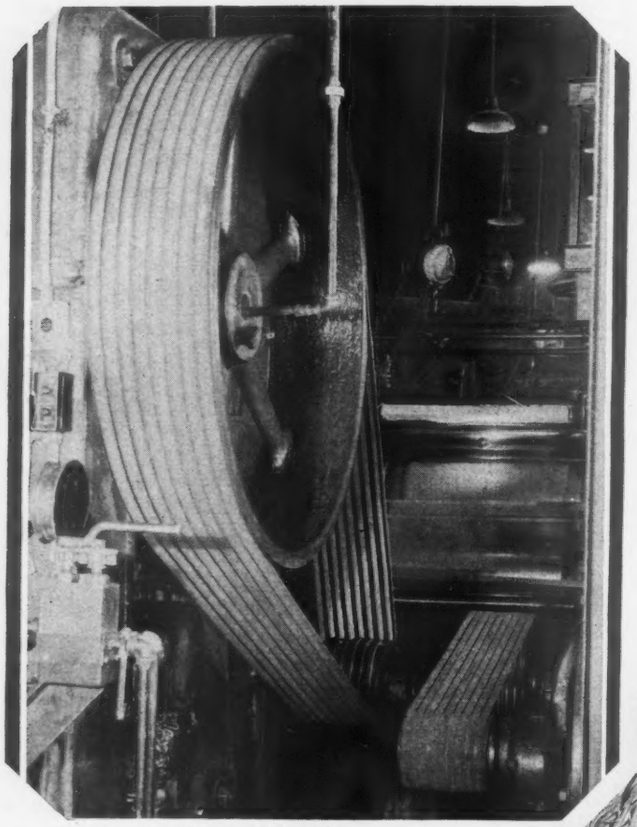


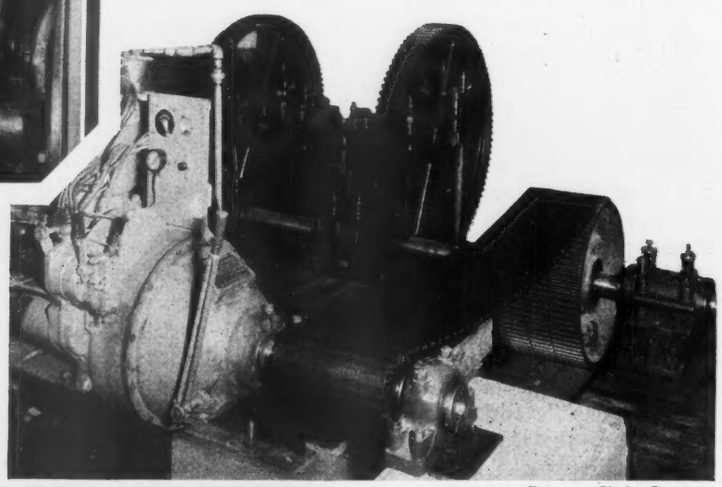
Fig. 19—Twenty sheet cutters that were driven by a single motor through a long lineshaft. Breakdown of motor or shaft caused all of the equipment and 40 people to be idle. As illustrated, the department now is operated with individual motor and control for each cutter. Production of the department has been increased 33-1/3 per cent.

MECHANICAL POWER DRIVES



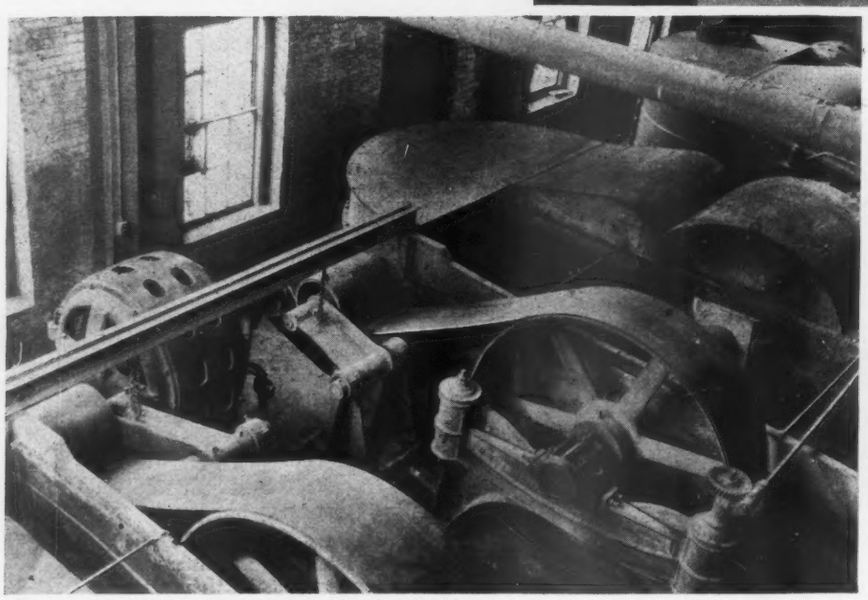
Courtesy Dodge Manufacturing Corporation

A large reduction in speed and a drive that is not affected by moisture were provided for a calendering machine by the two V-belt drives shown here.



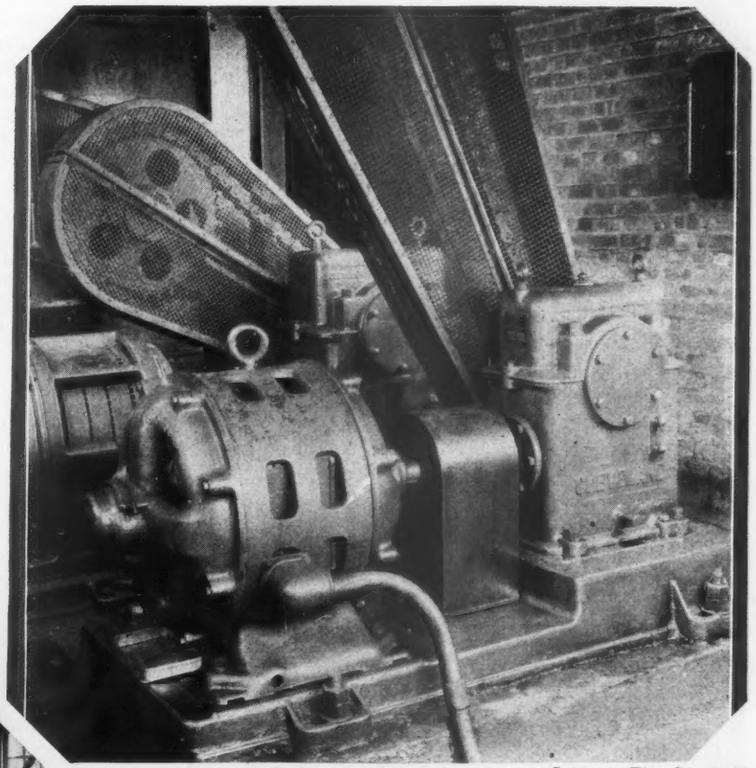
Courtesy Ramsey Chain Company

Plenty of shocks and jolts are the lot of this 14-in., 1-in. pitch silent chain which drives a triplex pump from a gasoline engine, in the mill of the Walkerville Paper Company, Walkerville, Ont., Canada. It transmits 100 hp., running at a speed of 1,750 feet per minute.



Courtesy The Cincinnati Rubber Manufacturing Company

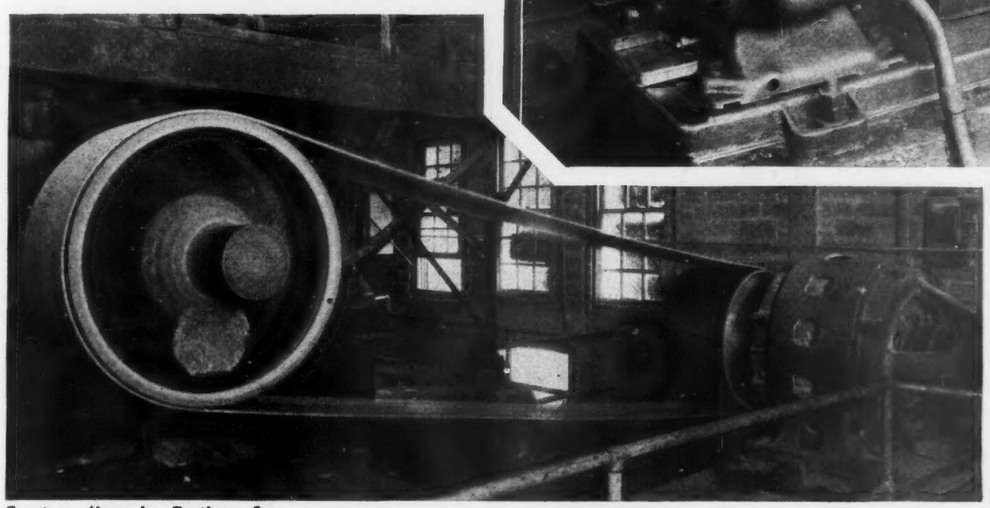
Excessive dampness has little effect on these 20-in., seven-ply, rubber belts driving beaters in a large paper mill. They transmit 145 hp. at 500 r.p.m. over 18- and 72-in. pulleys, on a center distance of 9½ ft. Proper tension is maintained by idler pulleys.



Courtesy The Cleveland Worm & Gear Company

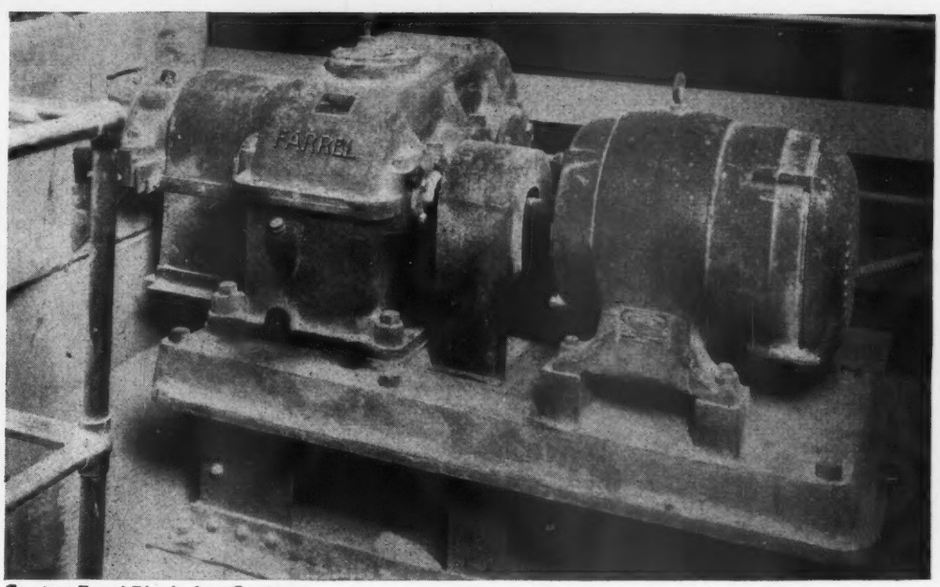
Conveyor and sugar elevator drives in the plant of the American Sugar Refining Company, Brooklyn, N. Y. The conveyor drive, at the rear, is rated 17 hp. with a reduction ratio of 5 to 1. A 35-hp. motor is used on the elevator drive, with a reduction ratio of 5 5/6 to 1.

Highly fluctuating loads with peaks up to 300 hp. make no difference to this 18-in. leather belt of special construction, which drives a 5½-ft. cone crusher at the Tullytown, Pa., plant of the Warner Company.



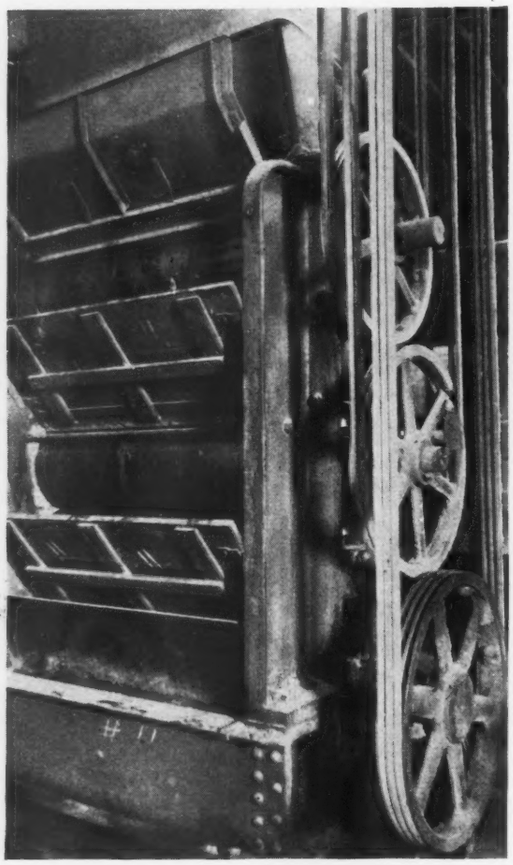
Courtesy Alexander Brothers, Inc.

Standing shocks and jolts is part of the day's work for the speed-reduction unit on a drag-chain conveyor drive in a gypsum plant. Shown is a 7½-hp. unit, with a ratio of 50 to 1.



Courtesy Farrel-Birmingham Company

MODERN EQUIPMENT AT WORK



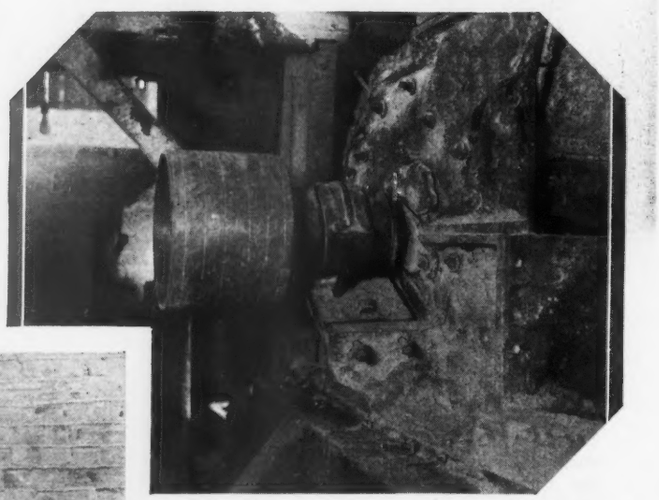
Courtesy Allis-Chalmers Manufacturing Company

Multiple V-belt drives, transmitting power to one of four 5-roll stands of 14x48-in. linseed rolls in the plant of the Wm. O. Goodrich Company, Milwaukee, Wis. The vertical drives from lineshaft to rolls (illustrated) are on centers varying in length from 112 to 168 in. Drive from 75-hp. motor to lineshaft (not shown) also is multiple V-belt, on 50-in. centers, and is supported by special steel framework.

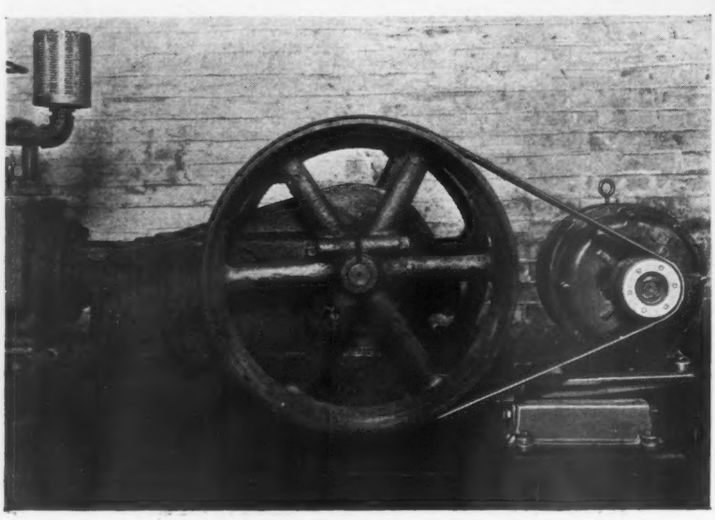
Courtesy Fabreeka Belting Company

Special impregnated-fabric belts have best met the grueling conditions imposed in driving the cooling tower fans in the plant of The Midvale Company, Nicetown, Pa.

Double ball-bearing pillow blocks equipped with dust seals stood hard service for more than a year on an oyster shell pulverizer in the plant of the Keeling-Easter Company, Norfolk, Va. Babbitted bearings formerly used lasted only two months.



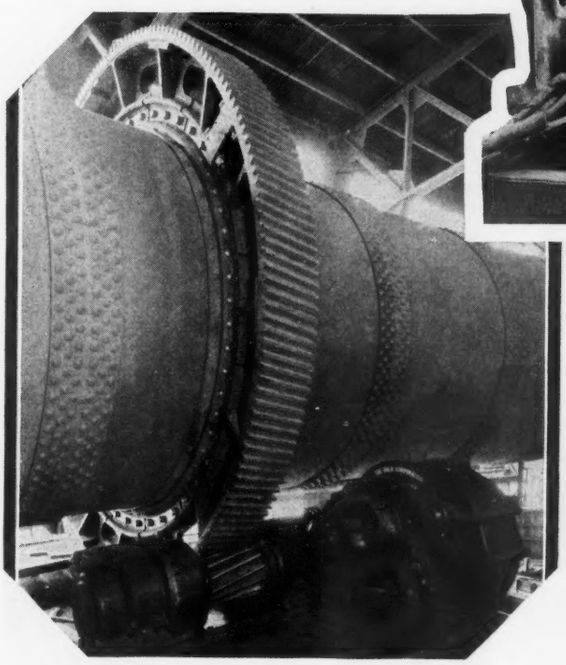
Courtesy The Fafnir Bearing Company



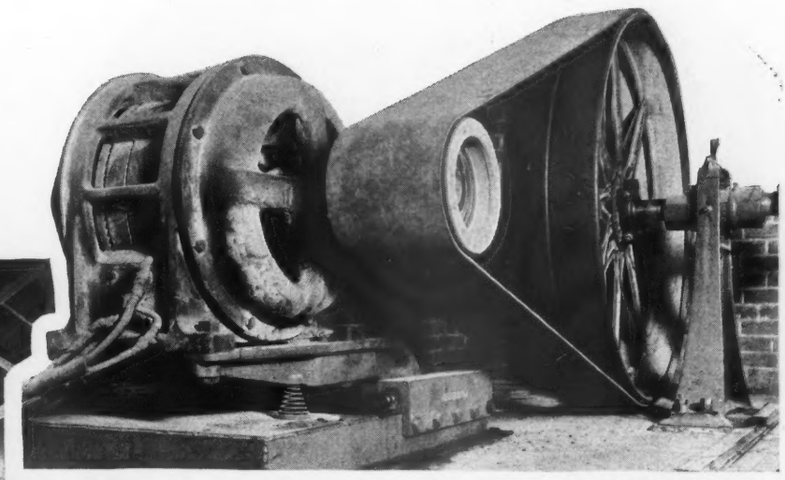
Courtesy The Rockwood Manufacturing Company

Correct tension of the leather belt on this short-center drive for a compressor is maintained automatically by the weight of the 10-hp. motor, which is mounted on a base that is pivoted at one end.

A drive for a large kiln in the plant of the Southwestern Portland Cement Company, Osborn, Ohio, that takes less power than is required to operate smaller kilns in the same plant.



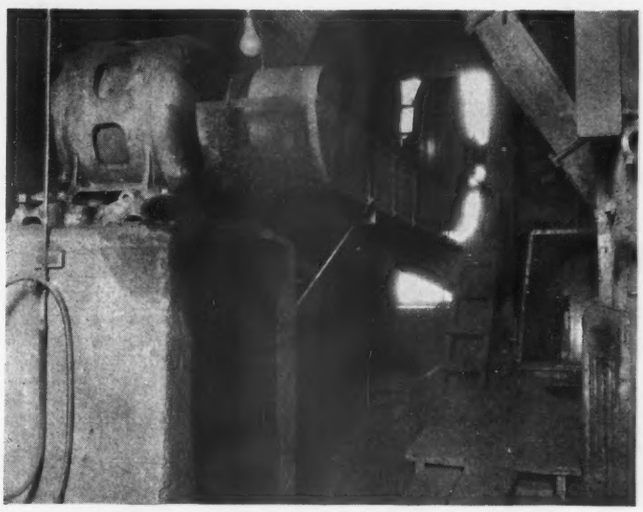
Courtesy The Falk Corporation



Courtesy E. F. Houghton & Company

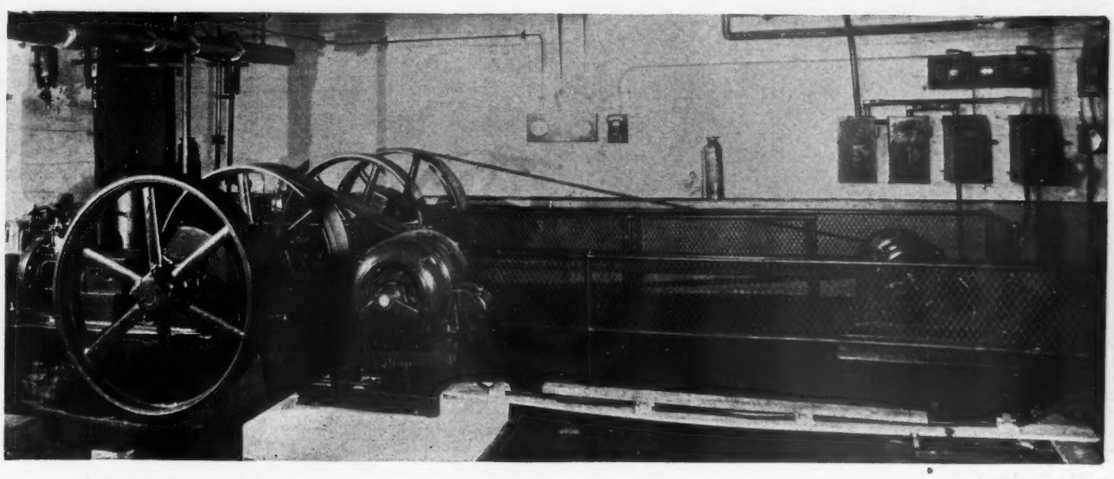
Driving a soap mixer under varying load conditions, a 12-in. double-leather belt transmits 50 hp. through 13- and 60-in. pulleys on a 66-in. center distance.

A 12-in., six-ply, rubber belt that has given twice the length of service formerly obtained in a dry pan drive in the plant of Fiske and Company, Watsontown, Pa. The motor pulley is 16 in. in diameter; driven pulley, 72 in.; center distance, 18 feet.



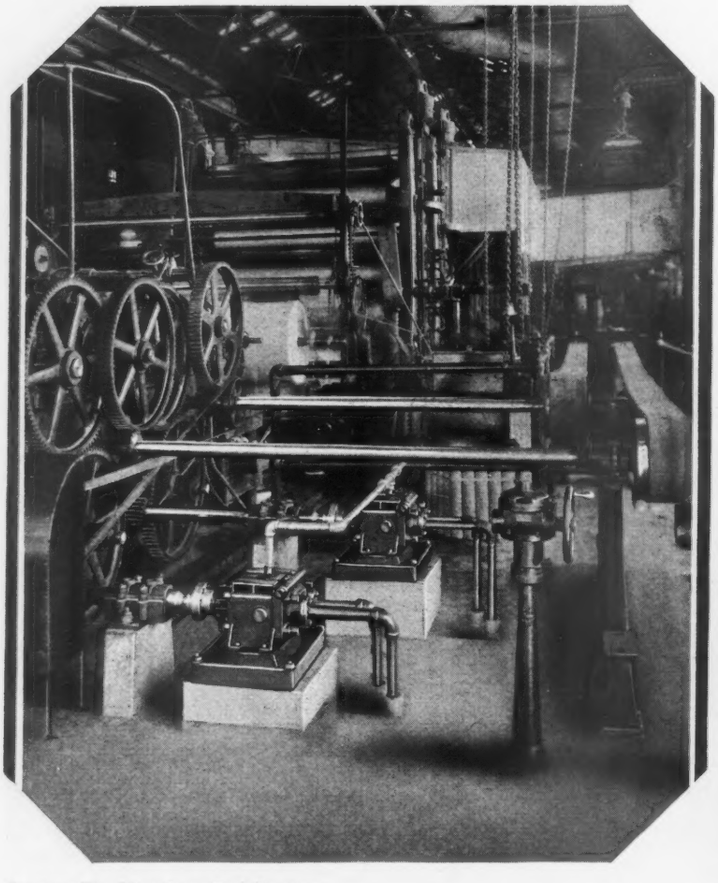
Courtesy The B. F. Goodrich Rubber Company

Valuable floor space was saved by changing one of two ice machine drives to the short-center type. The motor is rated 40 hp., 1,200 r.p.m., speed ratio 7 to 1. Distance between centers is 54 inches.



Courtesy Chicago Belting Company

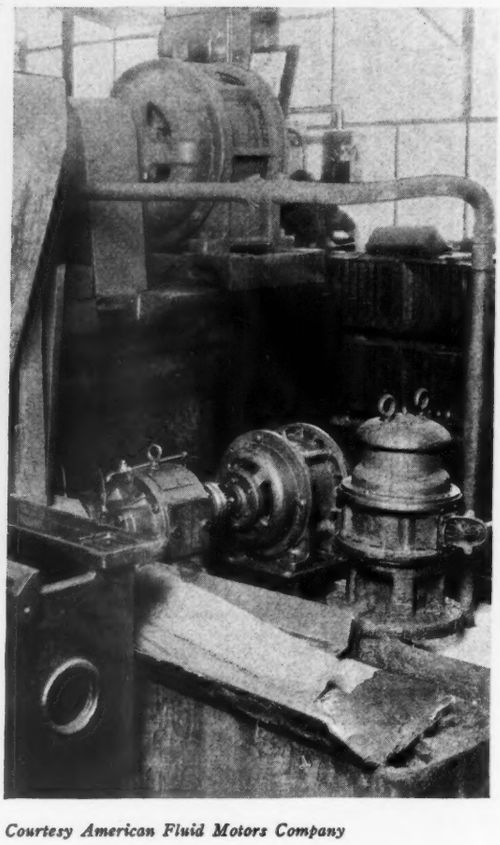
MODERN EQUIPMENT AT WORK



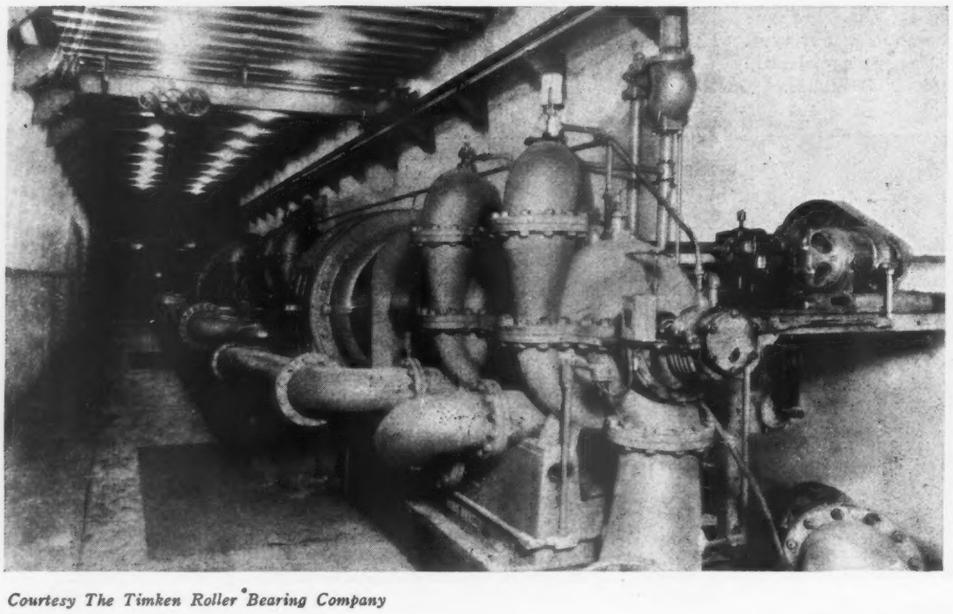
Courtesy The Waterbury Tool Company

Length of sheets cut on the double paper-board cutter illustrated may be varied and controlled within 1/16 in. through its hydraulic drives. The pumps for the drives are operated from the same variable-speed lineshaft that drives the paper machines, so that variations in their speed will not affect the length of the sheets.

By means of a hydraulic transmission the table of a grinding machine in the plant of the American Engineering Company, Philadelphia, Pa., may be driven at any desired speed, in either direction of rotation. The saving made by this method of control is estimated to be 30 per cent.



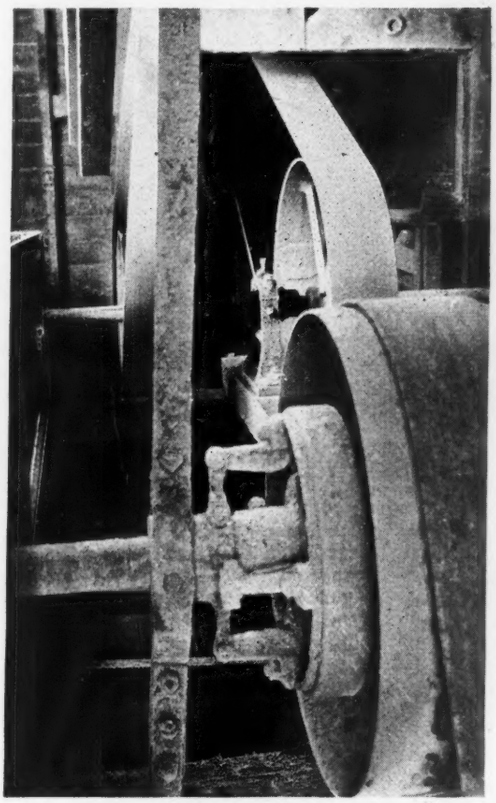
Courtesy American Fluid Motors Company



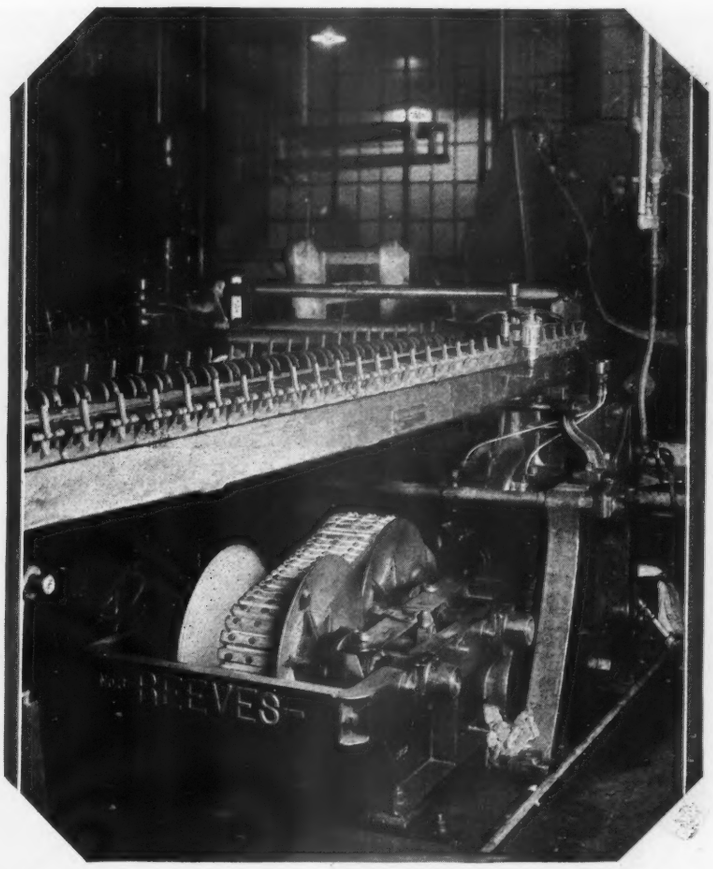
Courtesy The Timken Roller Bearing Company

Installation of tapered-roller bearings in two mine pumps in the St. Michael shaft of the Berwind-White Coal Mining Company, Cambria County, Pa., eliminated water cooling of the bearings, formerly necessary.

Exposed to highly corrosive fumes in the acid phosphate department of the Southern States Phosphate and Fertilizer Company, Savannah, Ga., rubber belts last from two to three years as compared with two weeks' to one year's service formerly obtained.



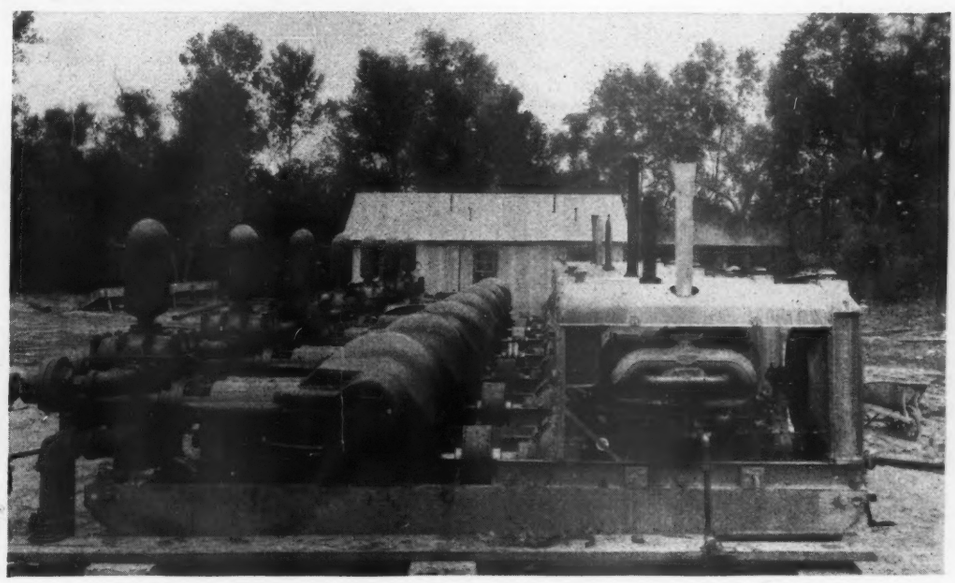
Courtesy Thermoid Rubber Company



Courtesy Reeves Pulley Company

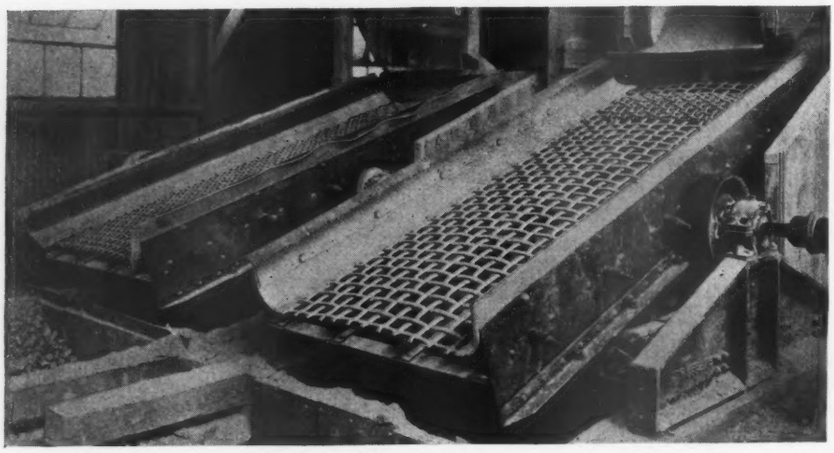
A variable-speed transmission in the drive for a tenter frame for processing silk in the plant of the United Piece Dye Works, Passaic, N. J., gives a speed variation over a 5 to 1 range.

Sturdy clutches do their part in keeping the engine-driven gasoline pumps on the job at the refinery of The Gypsy Oil Company, Tulsa, Okla.



Courtesy Twin Disc Clutch Company

MODERN EQUIPMENT AT WORK



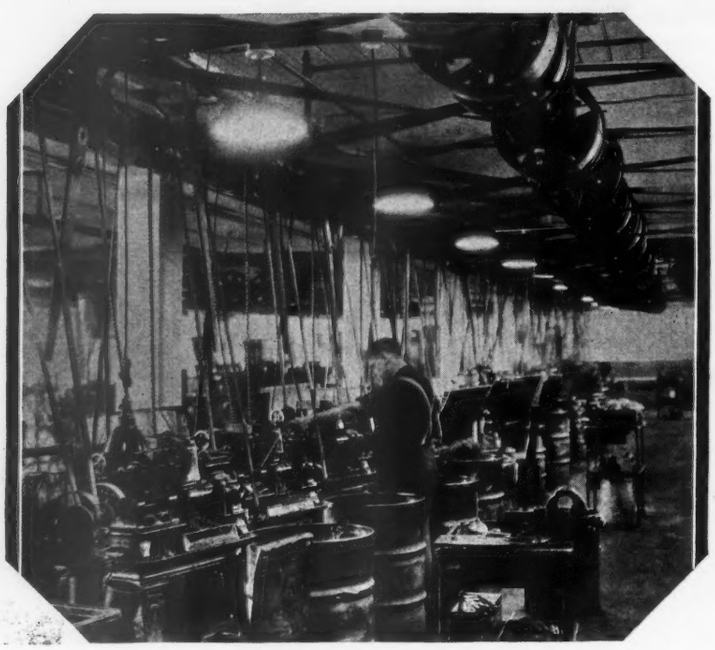
Worth-while savings in power and maintenance followed the installation of roller bearings on the screens in a crushed stone plant. Eccentric action and shaft vibration make the operating conditions especially severe.

Courtesy Shafer Bearing Corporation

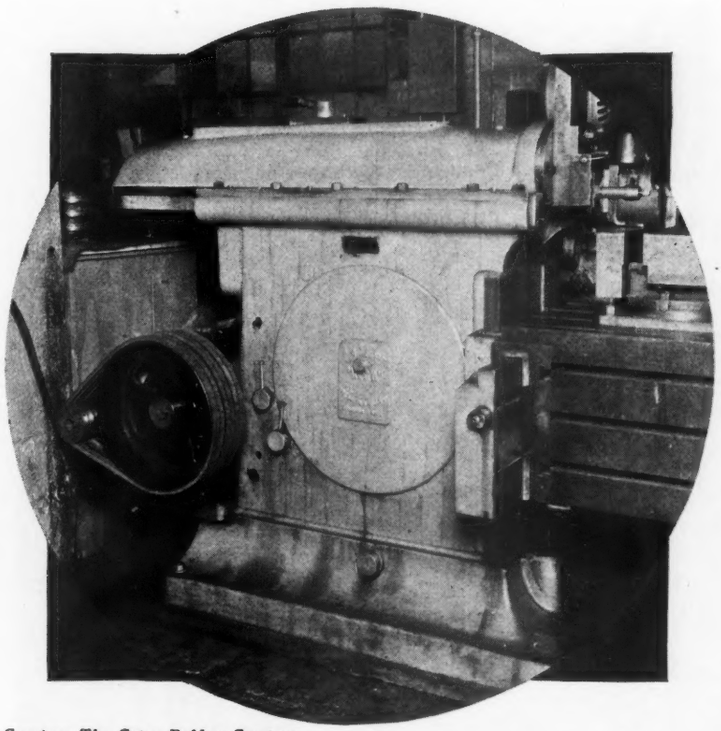
Here the problem of obtaining the great reduction in speed necessary for a vertical chain conveyor was solved by a 72 to 1 speed reducer and a high-ratio roller chain drive.

Courtesy Winfield H. Smith, Inc.

One hundred screw machines are driven by 5/8-in. pitch roller chains from an overhead lineshaft.

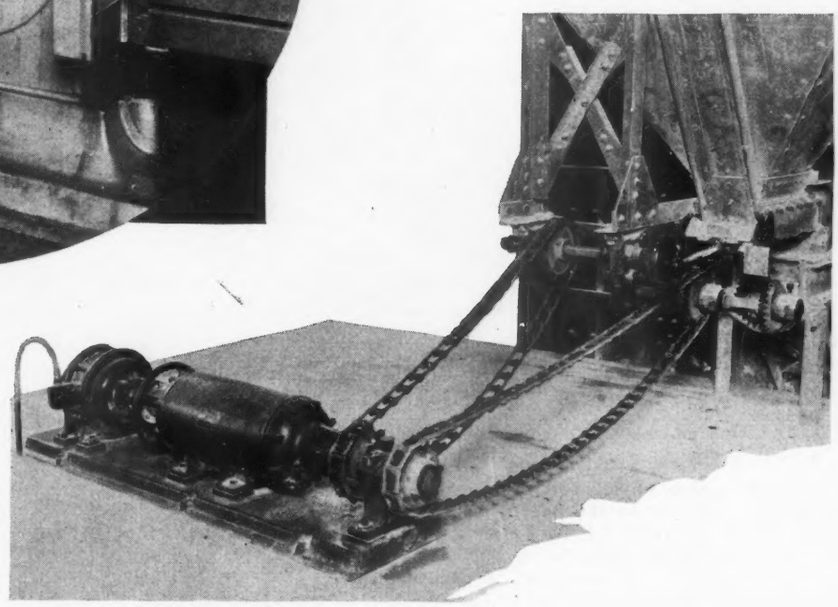


Courtesy Baldwin-Duckworth Chain Corporation



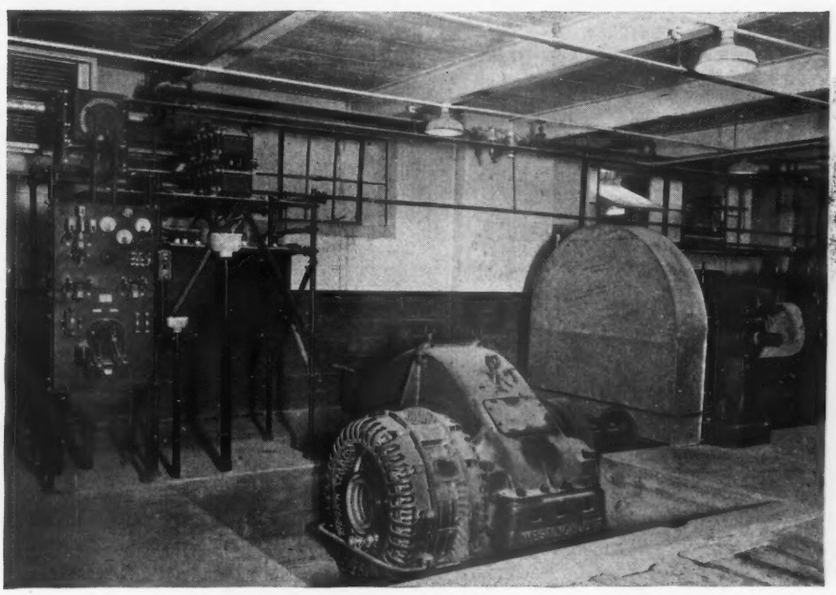
Courtesy The Gates Rubber Company

When putting a multiple V-belt drive on a shaper, money was saved by fitting a flat steel band over the main gear, and running the belts directly on it, instead of using a grooved pulley.



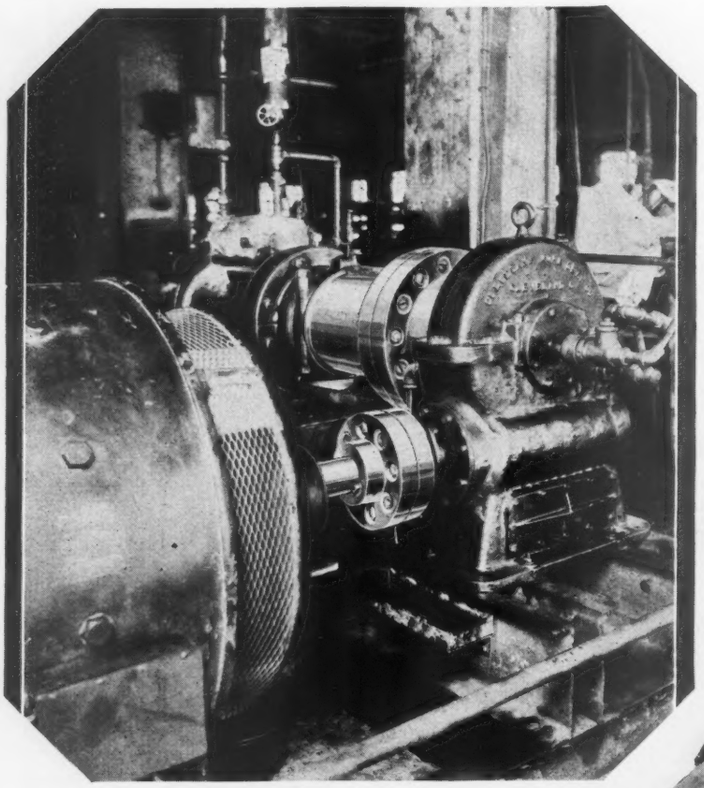
Courtesy Stephens-Adamson Manufacturing Company

Close control of the rate of feeding material through a cylindrical drying furnace at the plant of the Eagle-Picher Lead Company, Clearing, Ill., is obtained by driving the reciprocating plate feeder and the screw conveyor to the furnace through a variable-speed transmission.



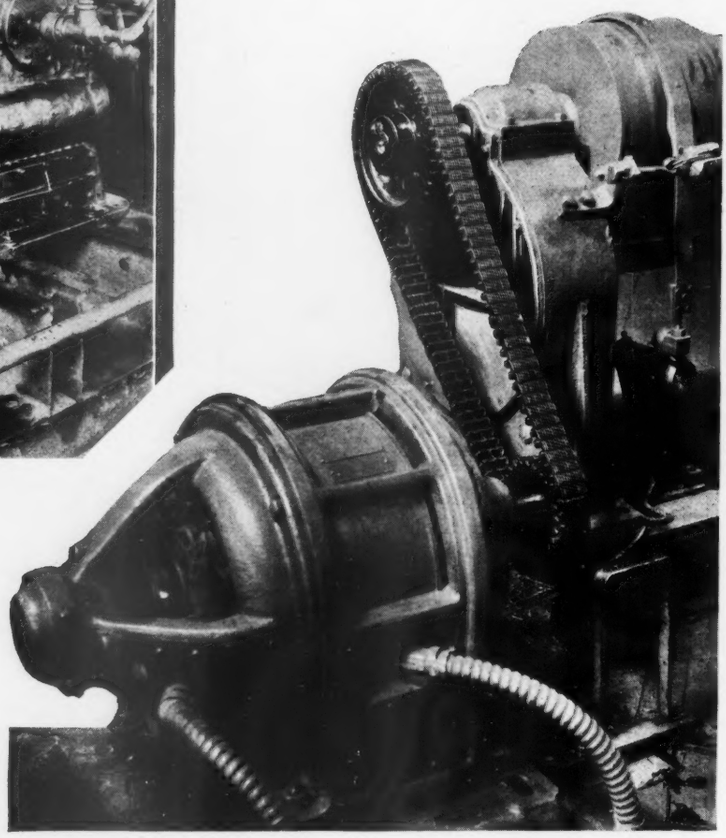
Courtesy Westinghouse Electric & Manufacturing Company

One motor bearing and coupling are eliminated in this modern drive for three 60-in. rubber mills in the plant of the Gillette Rubber Company, Eau Claire, Wis. The rotor of the 250-hp. driving motor is mounted on the high-speed shaft of the reduction gear unit.



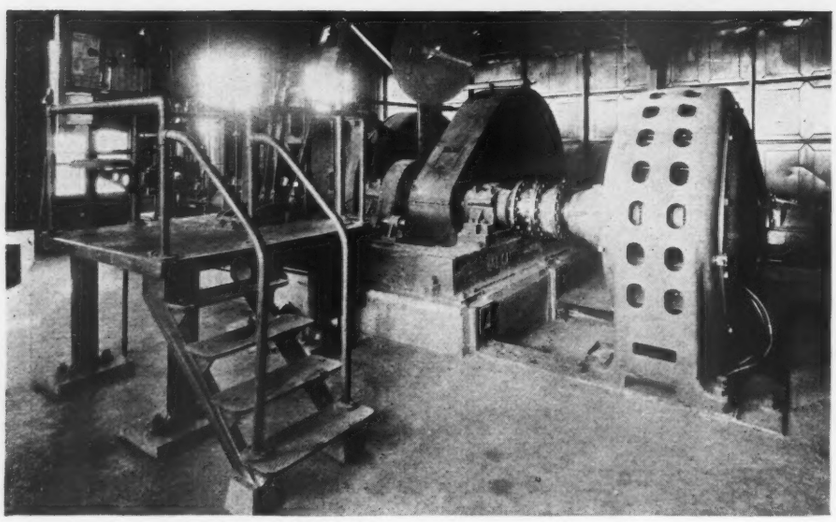
Shocks and jars from a special, heavy-duty machine in the plant of The Firestone Tire and Rubber Company, Akron, Ohio, are absorbed by two flexible couplings that protect the speed reducer and motor.

Courtesy Ajax Flexible Coupling Company



One of 200 similar silent chain drives in the Williamsport and Sparrows Point Mills of the Williamsport Wire Rope Company, Williamsport, Pa., transmitting from 5 to 40 hp. at motor speeds up to 1,750 r.p.m. (Housing removed.)

Courtesy Morse Chain Company



The 600-hp., 385-r.p.m. motor operating a hoist in the Loomis Colliery of the Glen Alden Coal Company, Nanticoke, Pa., is protected from shocks by a flexible coupling connecting the motor and speed-reduction unit shafts.

Courtesy The Bartlett-Hayward Company

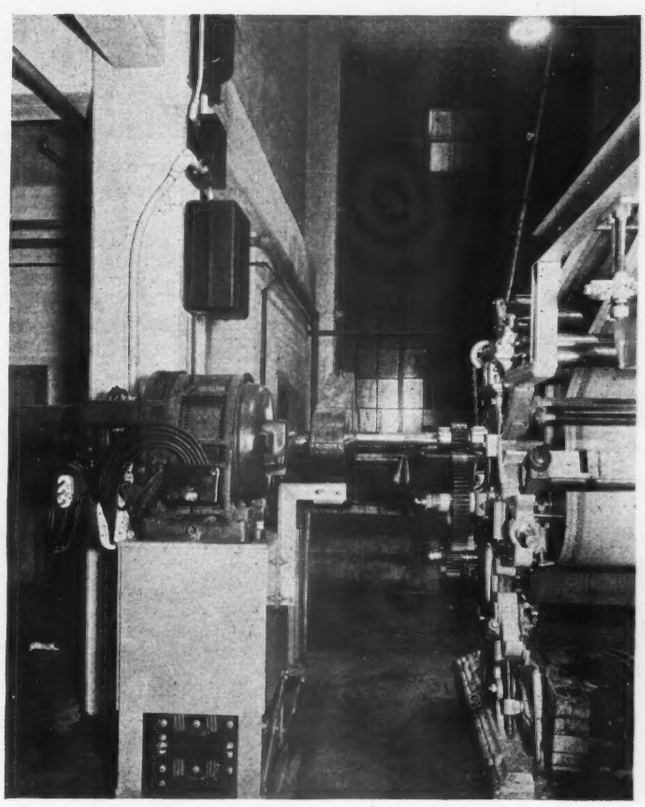
MOTORS AND CONTROLS

Courtesy The Louis Allis Company

Dangerous work—fires not tolerated. Shown are 11 of a battery of 40 3-hp., 1,800-r.p.m., explosion-proof motors, each driving an individual pump mounted above an underground tank. Location is the gasoline bulk storage plant of Shell Eastern Petroleum Products, Inc., Brooklyn, N. Y. Such motors are designed to prevent the escape of flame due to internal explosion. They are strong enough to withstand any explosion likely to occur inside. As would be expected, the motors also are weather-proof.

■ ■

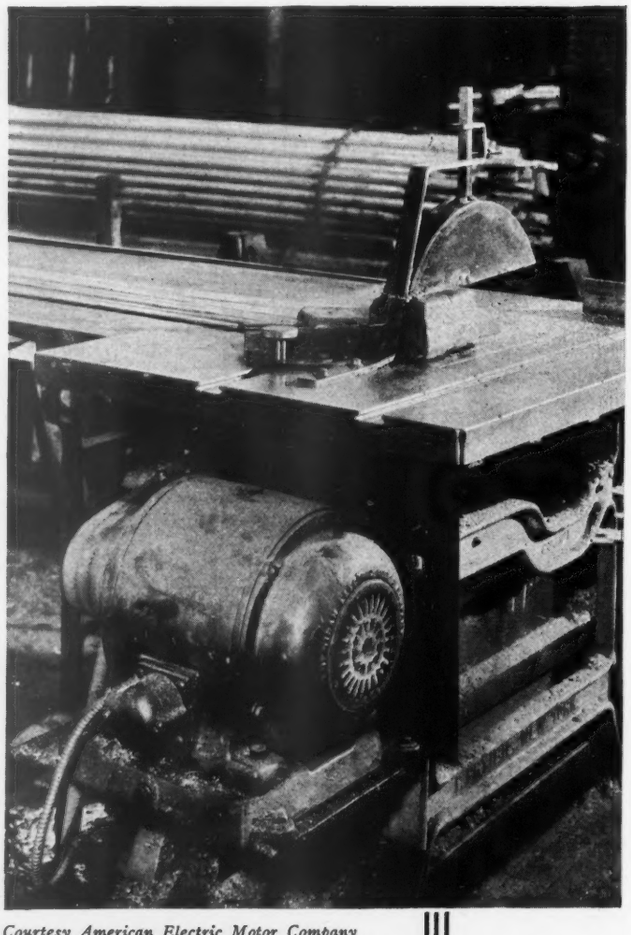
Variable speed is essential in any transmission equipment that is going to drive a printing machine. In the installation illustrated an adjustable-speed a. c. motor with 4 to 1 ratio is driving a four-color cloth printing machine in the plant of the Rock Hill Printing & Finishing Company, Rock Hill, S. C.



Courtesy General Electric Company

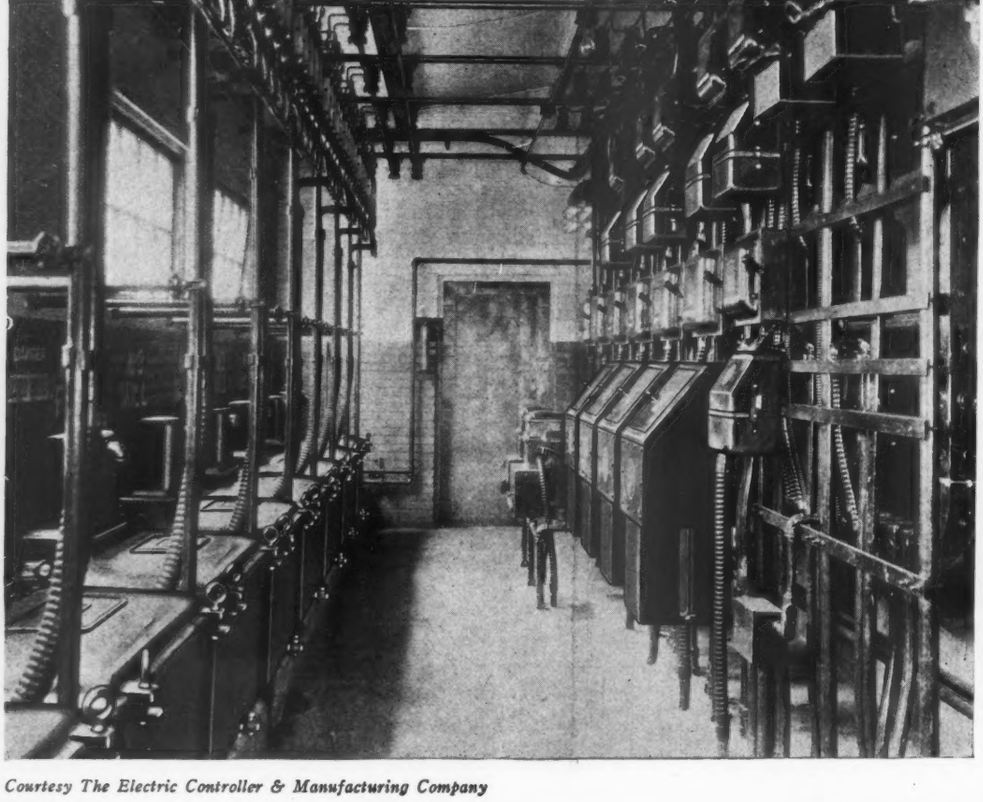
MODERN EQUIPMENT AT WORK

A totally inclosed, fan-cooled motor of 7½-hp. rating, running at 1,800 r.p.m., overcame trouble previously experienced with open-type motors. The job is sawing brass rods and the open-type motor frequently went down as a result of the spray of brass chips.



Courtesy American Electric Motor Company

An installation of motor starters in one of the control rooms of the International Nickel Company, Copper Cliff, Ont., Canada. Ranging from across-the-line starters for small motors to automatic compensators for 2,300-volt machines, the starters shown here control the motors driving fans, mills, and concentrators.



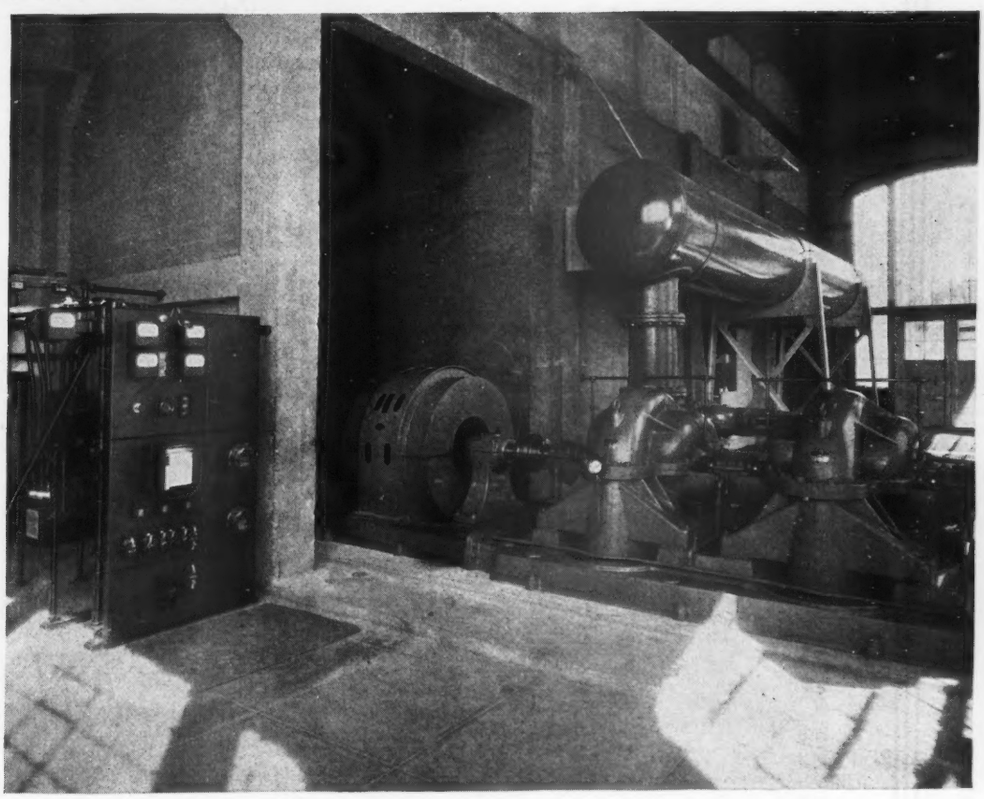
Courtesy The Electric Controller & Manufacturing Company

The motor shown is of the fully inclosed, fan-cooled type and is driving a rotary table sandblast machine. Periodic inspection of the bearings is the only attention that has been given this motor in spite of the fact that it cannot help receiving deposits of the sandblast grit used in cleaning cast parts. The motor has been engaged in this severe service for practically three years.

Courtesy The Reliance Electric & Engineering Company

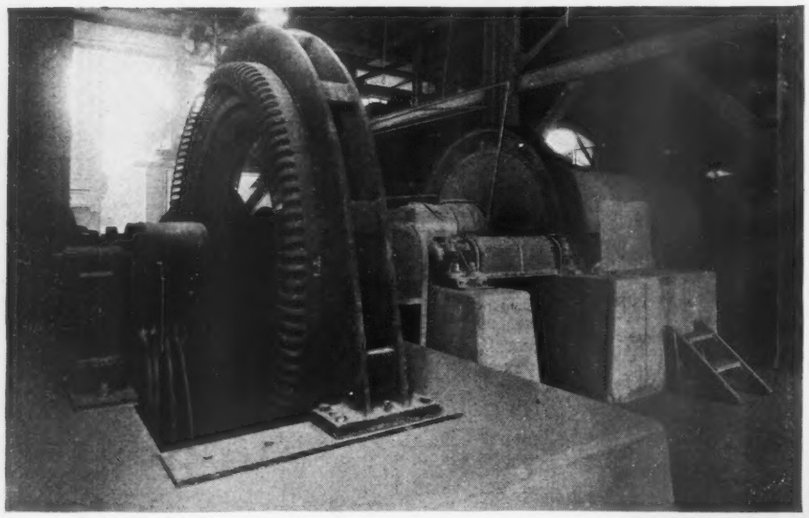
■ ■

A 1,250-hp. synchronous motor, operating at 1,200 r.p.m., driving a high-head centrifugal pump. Motor is of fabricated steel construction. The control utilizes two circuits in the motor armature winding to reduce starting current inrush. Autotransformer is eliminated.



Courtesy Electric Machinery Manufacturing Company

MODERN EQUIPMENT AT WORK



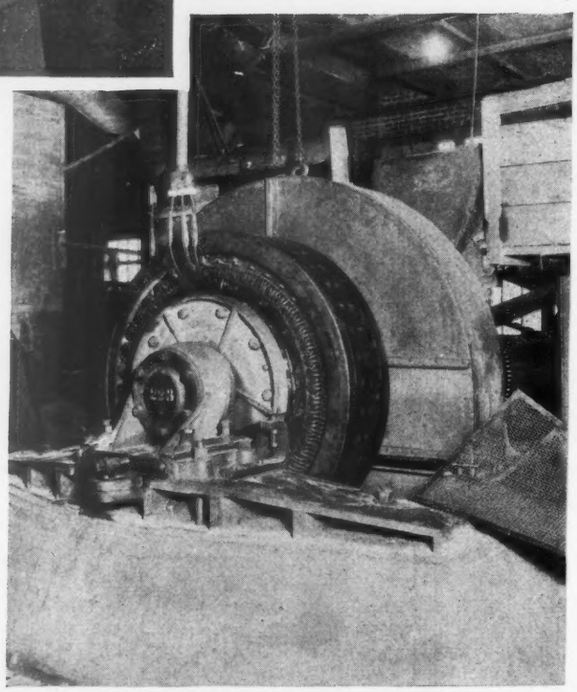
Smooth acceleration with low starting current characterizes the synchronous motor that is shown driving a tube mill for grinding cement. It is operating at 138 r.p.m. and is rated at 300 hp. The starting and pull-in torques are developed electrically and mechanical loading devices are eliminated. The installation is an example of selection of modern equipment to suit the job.

Courtesy Westinghouse Electric & Manufacturing Company

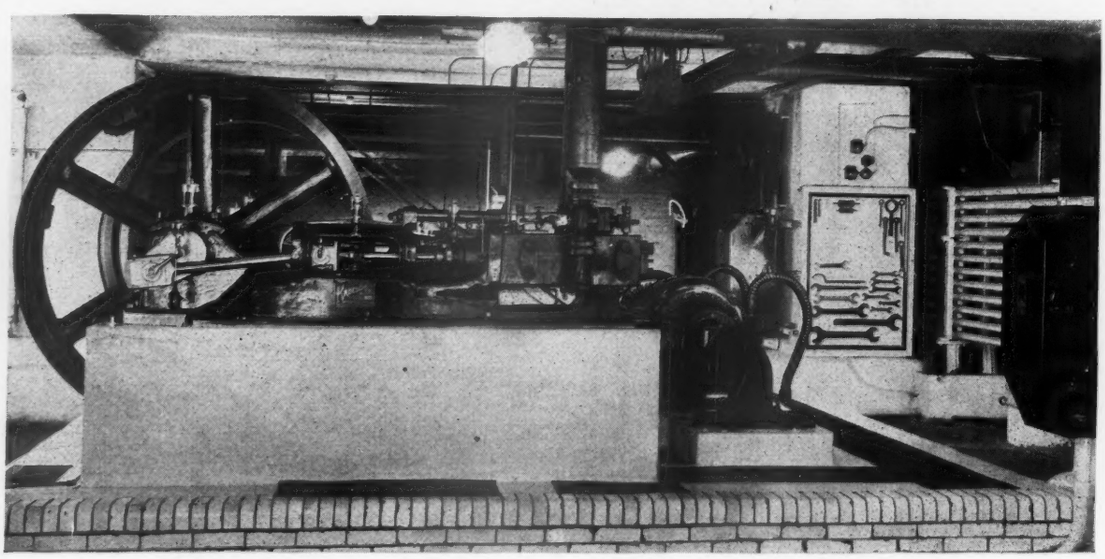
Chippers in pulp mills are operated with loads that are on the average severe, but which are made up of a series of shock loads and light loads. Shown is a direct-connected, 150-hp. synchronous motor of the flywheel type driving a chipper in the plant of the Mosinee Paper Mills, Mosinee, Wis. Power costs are low, shutdowns are negligible, and shock loads are absorbed by the flywheel momentum.

■ ■

Smooth acceleration, with overload and no-voltage protection, are afforded the two driving motors by the modern starters. The motors are driving a large CO_2 ice machine.

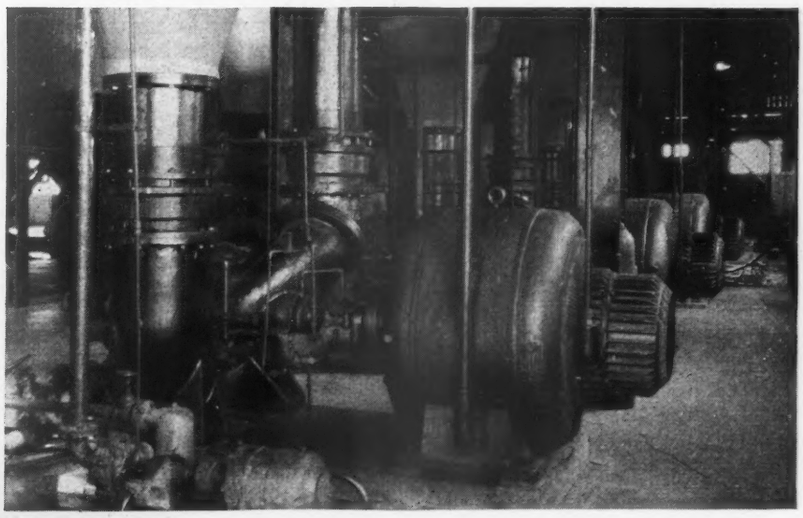


Courtesy The Ideal Electric & Manufacturing Company



Courtesy Allen-Bradley Company

A group of 100-hp., 600-r.p.m., totally inclosed, fan-cooled, 2,200-volt, synchronous motors driving black liquor evaporator circulating pumps in the new 300-ton pulp board and paper mill of the Southern Kraft Corporation, Panama City, Fla. All motors in the digester building are totally inclosed, because of corrosive gases and water hazard incidental to the washing of equipment.



Courtesy Allis-Chalmers Manufacturing Company

Courtesy The Lincoln Electric Company

In its factory at Cleveland, Ohio, The Lincoln Electric Company subjects the welded motor illustrated to service that is really severe. It is operated in the impregnating department where motor coils are dipped into water-proofing, chemical-resisting compounds.

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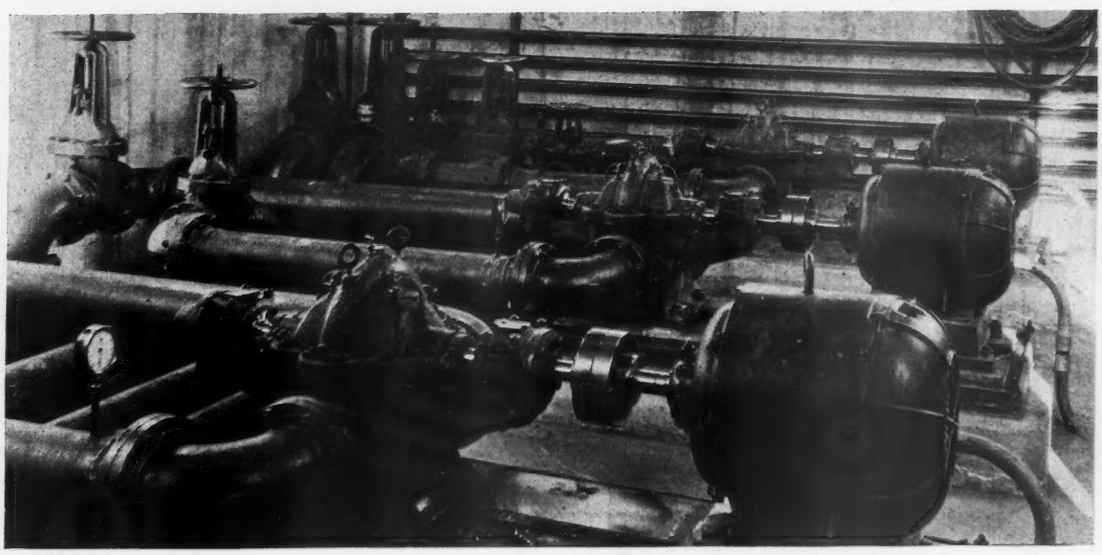
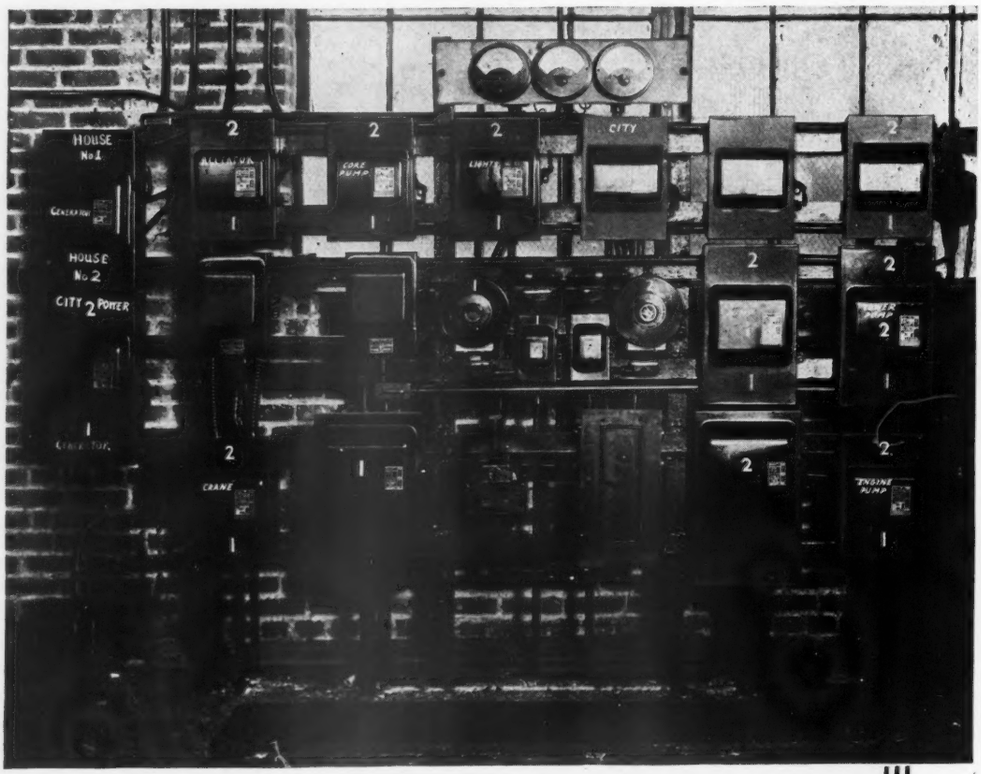
Totally inclosed, fan-cooled motors, efficiently driving circulating pumps in an oil refinery.



Courtesy Wagner Electric Corporation

MODERN EQUIPMENT AT WORK



Courtesy The Trumbull Electric Manufacturing Company

Sixteen double-throw safety switches comprise the bulk of the equipment on the unit panelboard illustrated, installed in the building of the National Ice Company, Shreveport, La.

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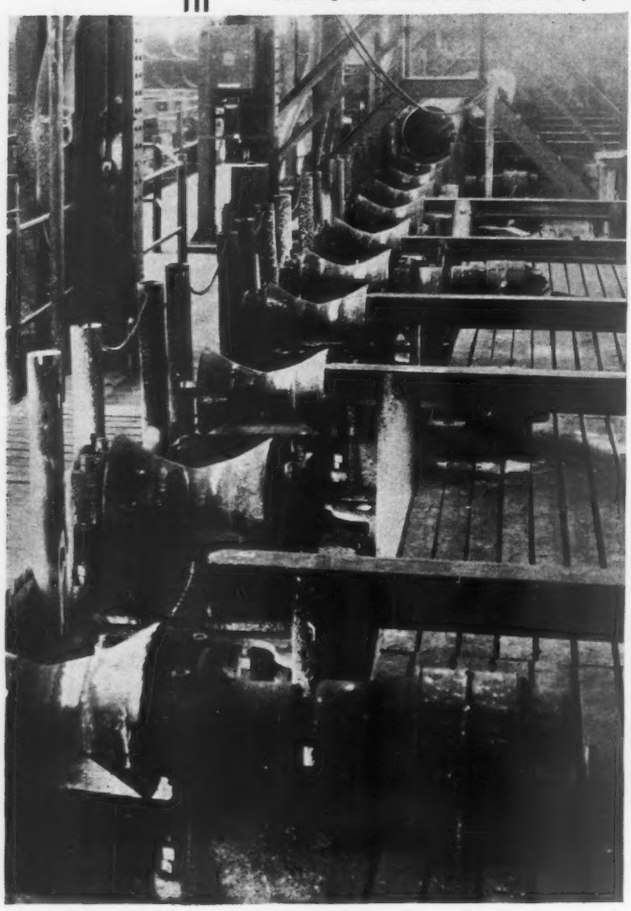
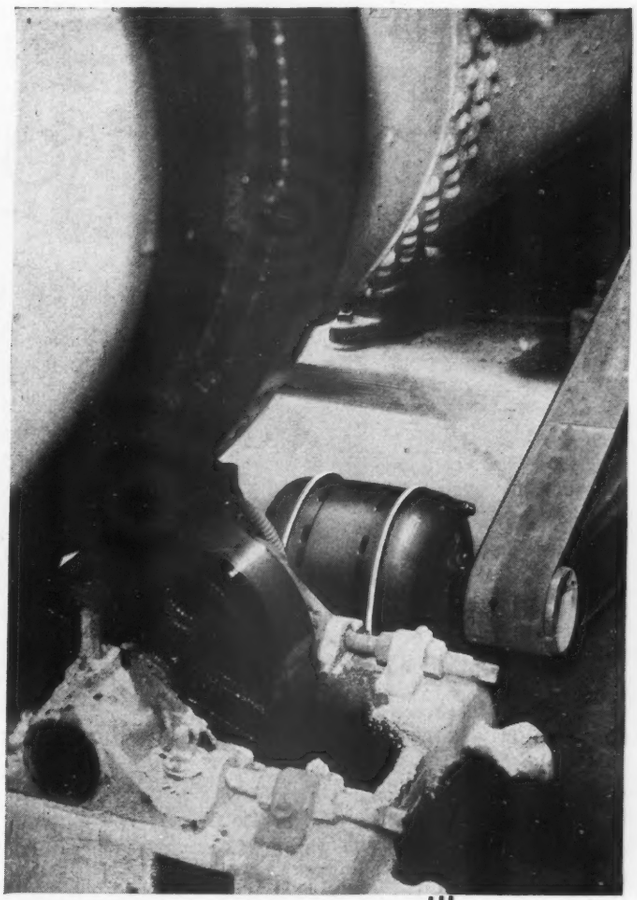


A group of adjustable-speed d.c. motors with speed changers driving conveying rolls in a tube mill. On account of heat and scale the service is classified as severe.

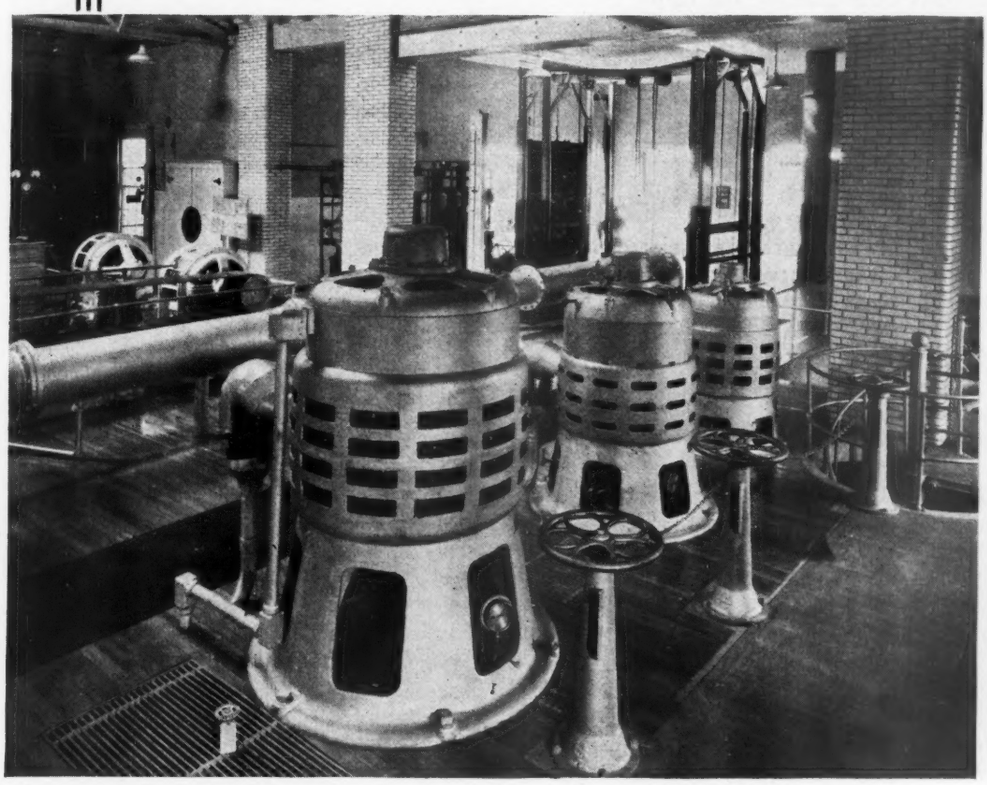
Courtesy Crocker-Wheeler Electric Manufacturing Company

Not the easiest work than can be found for motors is the driving of mixers. When mixer drums are large and material being ground is abrasive the service is classed as severe. Shown is a motor driving a mixer in the plant of the Chicago Vitreous Enamel Products Company, Chicago, Ill.



Courtesy Howell Electric Motors Company

Three vertical sewage pumps, direct-driven by motors rated at 100, 150, and 200 hp. Pump capacities are 6, 9, and 15 million gallons per day. Ball bearings, with which these motors are equipped, reduce motor maintenance materially.



Courtesy Fairbanks, Morse & Company

METHODS MODERNIZATION

ROBERT C. ROSS
Assistant to the President, in charge of Plant Operations
Jos. T. Ryerson & Son, Inc., Chicago, Ill.

Intensive study of service costs and application of modern maintenance methods eliminates hidden losses. The emphasis is upon methods, but of course equipment was involved.

EARLY in 1930, my company, which conducts a large steel-service business, was feeling, with the entire steel industry, the pinch of depression, characterized by decreasing tonnage and falling prices. Profits were diminishing because of the smaller volume of business.

Similar to the proverbial "ill wind," this situation produced one favorable condition: A substantial portion of the executives' time, which formerly had been required for the transaction of business, was released automatically for other purposes. Realizing that lower costs afforded the only hope of maintaining net profit under the conditions then existing, the management recognized this surplus time as affording opportunity to concentrate on cost reduction.

Because direct labor was compensated in proportion to the tonnage of steel handled by means of an incentive system, the ratio of direct costs to tonnage was practically constant. This fact, with a decreasing inventory, eliminated further investigation of direct costs, both material and labor being on a unit basis.

There remained, therefore, only the indirect or maintenance costs for analysis. A thorough survey was conducted of every indirect or maintenance division in the Chicago plant—no item was considered too insignificant for scrutiny.

After completion of the surveys the findings were recorded with the recommendations of the investigators in the form of reports. These reports were discussed in executive meeting, and definite action was taken on all recommendations that warranted it.

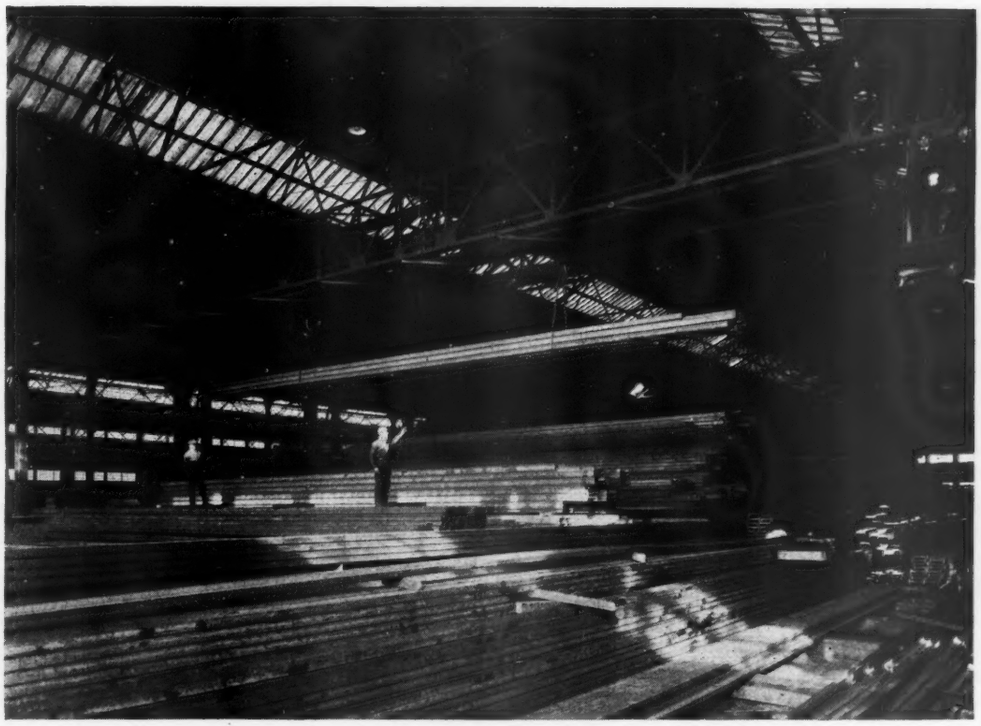
Beside the main plant in Chicago, the company operates nine other plants in principal cities. Conditions allowing, the improvements originating at the main plant were applied to one or all of the other plants, and similarly, ideas with their source at one of the other plants were applied to one or all of the remaining plants. The Industrial Engineering Department in Chicago, beside originating improvements, served as a clearing house for this interchange of ideas and methods, working in cooperation with the superintendents of the respective plants.

A description of the findings of the surveys, improvements made, and results follows under the appropriate headings to indicate divisions.

Power and Light—Electric power rates are determined in Chicago on the basis of the maximum demand, which is set one year ahead. If this maximum demand is exceeded, even for a short time, it immediately sets the rate higher for the year following the day that the power demand goes over the maximum value.

It was found that the peak power demand occured at about 11:15 a. m. on dark days because, at this time, the largest number of machines were drawing power from the line, and on dark mornings all the lights were switched on. The power curve was flattened out, cutting down the peak demand, by sending one large department to lunch at 11:15 a. m. instead of at noon, consequently shutting off all machines and lights in the department.

Construction of concrete driveways between buildings of the plant permits the same transportation units to be used between buildings as within them.



Prompt delivery of material to the customers of a steel-service plant is accomplished by the application of modern methods and equipment.

Control switches were rearranged so that just enough lights could be turned on to satisfy minimum requirements, for example, the light required by one man working alone in a department, where it had been necessary previously to light an entire row or section. Many lamps were found to be of higher wattage than was necessary for adequate illumination and were replaced by smaller lamps of exactly the wattage required. A campaign was inaugurated to instruct the foreman and men that they must shut off all motors and lights not in use. This program was thoroughly policed, and those not complying were disciplined. The effectiveness of this campaign was proved by the fact that many violations were reported at first, but they were finally cut down to one or two a month. Night watchmen were instructed that their first duty was to locate and turn off all motors and lights that were being operated needlessly after working hours.

Improved methods replaced waste in the following eleven divisions:

Power and Light
Water
Heat
Transportation
Supplies
Painting
Roofs
Janitor Service
Watchmen
Labor Policy

In spite of the reduction in maximum demand effected by these improvements, unusual conditions were still likely to produce a situation in which it would be exceeded. As a positive insurance against running over the maximum, a demand meter was installed in the maintenance office. The setting of the meter was such that a bell would ring whenever the power demand rose to a point slightly below the maximum demand. This arrangement allows sufficient time (about 10 min.) between the ringing of the alarm bell and the reaching of the maximum demand, for the maintenance men to disconnect an air compressor, drawing a large amount of the plant load, until the power demand drops enough to put it again on the line. This machine can be shut off for 10 min. without impairing the plant air supply because its compressed air tank holds enough reserve to operate the plant for this period. If this action should not be sufficient to halt the rising power demand, one of the large friction saws can be shut off. However, this extreme measure has not yet been necessary.

In taking over a plant in another city, it was found that electric power was being supplied from two sources, requiring two meters. Combination of these two lines into one entailed an expense of $700, but which saved $800 annually in the power bill.

Water—The first step in the investigation of water distribution was to check the estimated amount of water required for each item supplied through any given meter. The entire system was then scrutinized for leaks, and those found were immediately stopped. By comparing the amount of water flowing through each meter against the sum of the estimated consumption of the items fed through the meters, a check was obtained on the tightness of the system. In one case a large discrepancy was detected between two volumes of water. Consequently the lines in question were re-inspected with utmost care with the following gratifying discovery: A serious leak was found that had escaped previous detection because the pipe was buried and discharging into a sewer. This one leak alone was costing the company over $700 annually. This method

of locating leaks was employed in all other plants; one bad leak was caught before much water was lost.

A noteworthy discovery was made in checking the water used to flush the plant urinals. It was found that flushing was going on continually, day and night, in spite of the fact that the plant was operating only on day shifts. Immediate installation of control valves between the flush tanks and the urinals permitted the water to be turned off at night and on in the morning. This simple installation cut the flushing time from 168 to 57 hr. weekly and resulted in a $2,000 annual reduction in the water bill when applied to all of the company's plants.

Recirculation into the main line of the cooling water for the ice machines and air compressors, which previously had been wasted, effected another economy. The refrigeration system for cooling drinking water was discovered to be in operation the entire year. It was found that, because the cold weather chilled the water sufficiently during the winter months, the system could be shut down for this period.

Installation of fountain-type electrical refrigeration systems to supply drinking water in five plants eliminated the necessity for the ice and paper cups required to operate the ice-tank units that were replaced. The saving will pay for the equipment in less than two years.

Heat—All steam generated in the plant is used for heating purposes. Adequate heat is of utmost importance in a steel-service plant, not only to provide comfortable working conditions, but also to keep such items as cold-finished steels, bars, bands, sheets, and wire free from moisture by storing them in heated areas.

By the use of flowmeters the amount of steam supplied to different areas was checked. This investigation proved that more insulation on certain lines would more than pay for itself in reduced heating costs. Further reduction was obtained by changing over the sprinkler system from the wet-pipe to the dry-pipe type, thus eliminating the necessity for supplying heat to certain areas in which heat was necessary only to prevent sprinkler lines from freezing. Another method of reducing steam consumption was to heat one warehouse with exhaust air used for heating the office. Because the boiler room has a larger capacity than is necessary for present plant requirements, it proved most profitable to operate close to capacity and sell metered steam to a neighboring plant. On the contrary, conditions at several of the plants were such that it proved more economical to purchase steam from a neighbor.

Boiler room personnel was reduced by two men in the night shifts by transferring the watchmen's headquarters from another part of the plant to the boiler room.

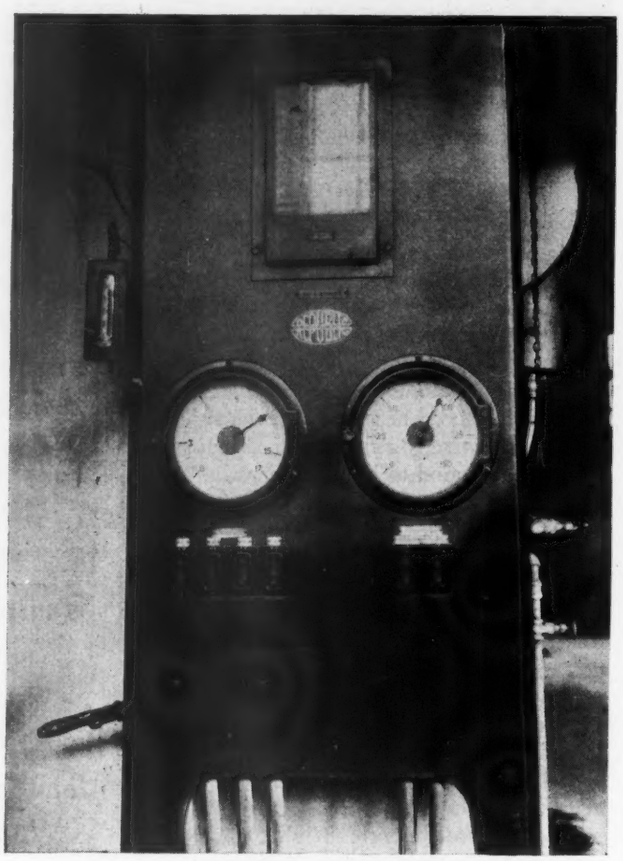
A large number of salamanders are used to heat portions of the plant not covered by the regular steam heating system; usually they are located near the machines or at other points where men are at work. Redesign of the salamanders to include a fine mesh grate and a stack permitted the use of a cheaper grade of coke.

Transportation—Materials transportation costs were reduced $300 monthly by using intraplant units for interplant service because of the lower operating costs of the smaller units. To effect this saving it was necessary to lay concrete runways between the different buildings.

An investigation of the fleet of delivery trucks brought about the replacement of several large machines using solid tires with lighter and faster units equipped with pneumatic tires, thereby reducing maintenance costs and speeding deliveries.

Equipment—Our practice always has included regular inspection of equipment to eliminate major repair items and keeping records of maintenance expense for every piece of equipment in our plants. In consequence inspections were made more complete and maintenance costs were scrutinized with greater care. In some cases the necessity for purchasing new equipment was avoided by transferring idle equipment from another plant. In other cases it proved more economical to scrap the equipment and replace it with new.

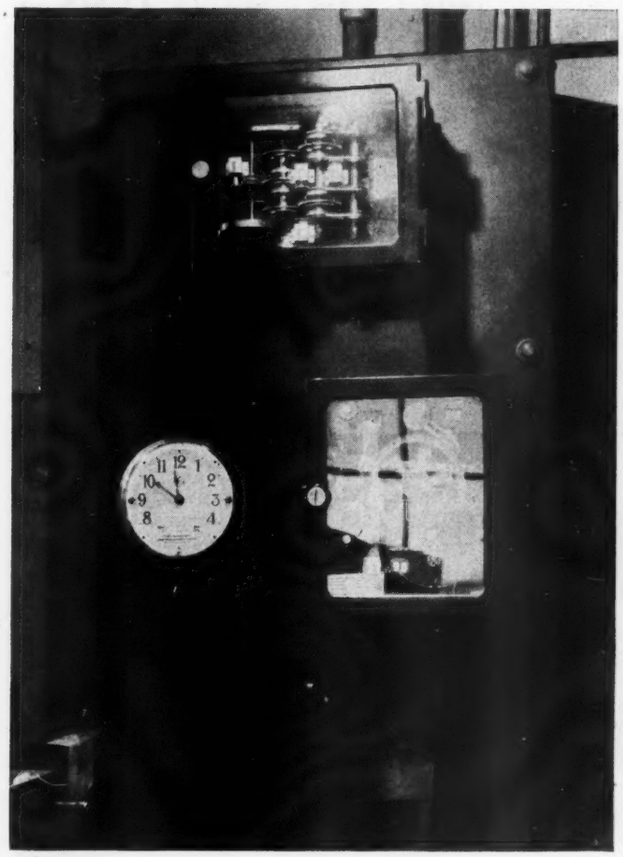
A good example of the latter case was brought to light at one of the other plants. Maintenance costs on four crane hoists were found to be excessively high. After an investigation it was decided to scrap the four hoists, rebuild two hoists from the salvaged parts of the four, and purchase two new ones. The total cost of the installation was $7,500 but it saved $2,400 annually in maintenance costs.



Excessive heat losses were detected in several steam heating lines through the use of flowmeters.

The company maintains a machine design department, which continually is devising equipment and attachments to improve the plant machinery. Through the efforts of this department it was possible to increase the speed of the automatic hacksaws from 125 to 165 strokes per min. with equally good results, despite the predictions of the manufacturers of the saws that it couldn't be done.

Supplies—Supervisors and foremen were instructed to make certain that operating supplies were being used economically and that no waste existed. Stocks were kept to a minimum by periodic inspections of the supply store room by maintenance men in which obsolete and excessive supplies were noted. The purchasing department constantly was scrutinizing the markets for cheaper and better supplies and, by its cooperation with the maintenance department, it was found that many supplies stocked in two or more grades, sizes, or brands could be standardized into one.



Electrical power control is centralized in the maintenance office, where a demand meter constantly records power demand, ringing a bell when it becomes excessive.

Lumber previously wasted was salvaged for crating. Damaged wire out of regular stock was utilized for bundling. Galvanized, one-pass, cold-rolled, and special sheets were stocked in sealed air and watertight packages, made by wrapping them in waterproof paper and sealing the joints with glue. Experimentation proved that pitch mixed with creosote at 1¼ cents a pound would do the job as well as the glue at 20 cents. Dull hacksaw blades formerly scrapped were reclaimed by re-sharpening several times, the work being done by the toolroom keeper.

Painting—As a result of a study of plant painting requirements, two painters were hired, and yearly requirements so scheduled to give them steady work for the entire year, thereby evenly distributing expense. This method, beside permitting a greater amount of work, has shown a saving of $2,500 a year over the former method of turning over all painting to outside contractors.

Roofs—By checking the results of a thorough investigation of the company's 50 acres of varied roofs and roofing with the past history of each roof, the condition and maintenance expense of each roof were obtained. An enlightening fact brought out by this study was that several sheet steel roofs composed of 16-gage steel had no expense charged against them in twenty years, while those made of the lighter 20-gage steel required repair within five or six years. Because the difference in price of the two thicknesses of steel was outweighed considerably by the saving in maintenance expense, the 16-gage roofing was made standard for future installations

Another discovery made in this survey was that the cost of cleaning windows in the monitor-type roof was materially lower than that of those types of roof containing sloping skylights. In consequence monitor-type roofs were selected as standard for future buildings and, in one case, it proved most economical to build a monitor on a roof that was previously of the sloping type, changing the location of the windows from the sides of the slope to the vertical sides of the monitor.

Janitor Service—The survey of the plant cleaning included a study of the areas cleaned and the frequency of cleaning them. It was found that many areas were being cleaned more often than necessary and, in one case, a vacant office was being regularly swept for no logical reason. As a result a cleaning schedule was made up and rigidly adhered to, materially cutting costs. All supplies used were budgeted monthly for each supervisor. One effect of this program was that the supervisors vied with each other to see which one would come the furthest under his budget at the end of the month.

Watchmen—A change in the clocking system used by the watchmen in several plants saved $2,000 a year.

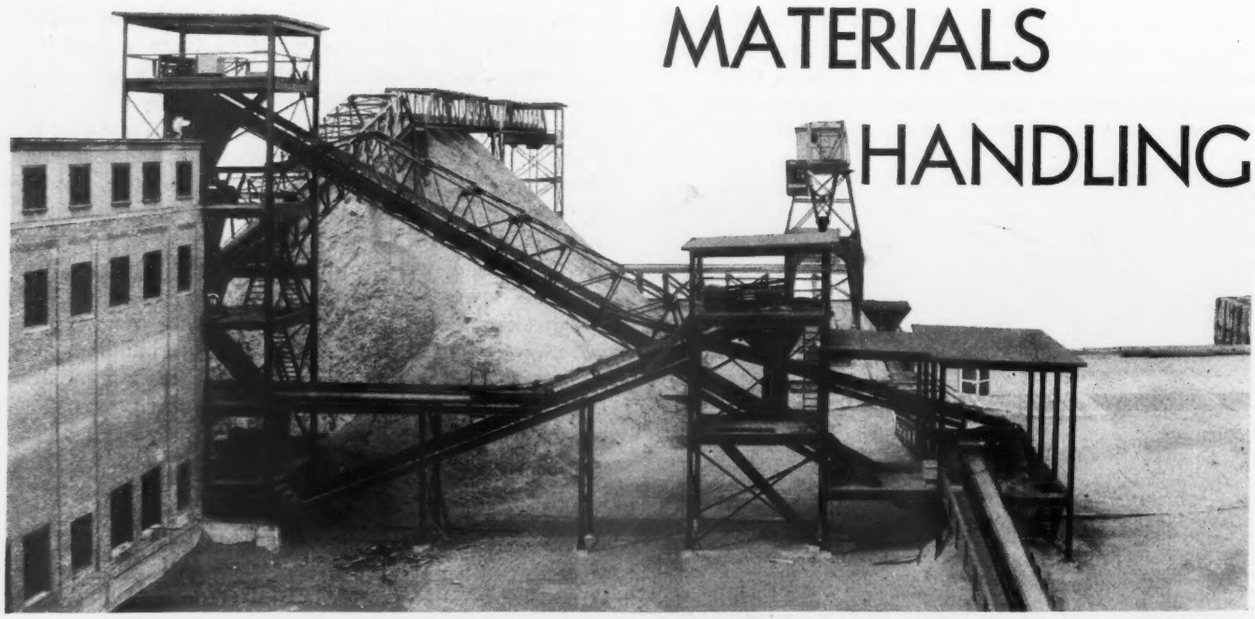
Labor Policy—It was decided that the lack of activity afforded an excellent opportunity to train key men for future development work. The method used to develop these men was to rotate them through all departments, giving them an insight into the entire business.

Indirect labor was controlled more closely by a daily report recording all the time spent on each job. When excessive time was indicated on the report for a certain job it was taken up with the foreman. The effect of this method of control soon was reflected in reduced indirect labor costs.

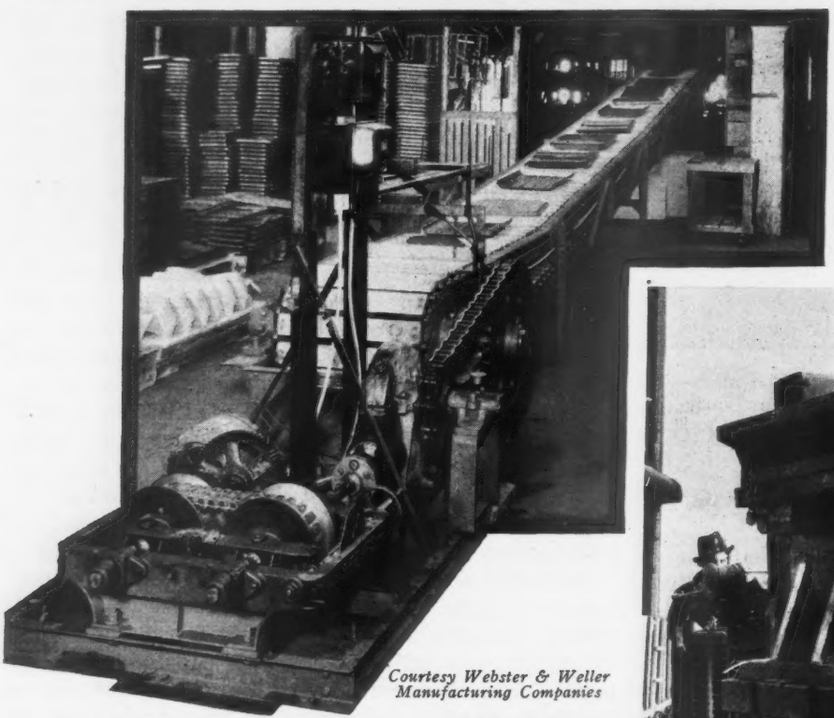
Instead of releasing the men either temporarily or permanently, the labor policy of rotating them was adopted. Rotation is accomplished in weekly cycles, the time being divided up as equally and justly as possible among the entire force. Every Friday each foreman forecasts as closely as possible the number of men needed for the following week. Those not needed are laid off for that week according to the schedule of rotation.

We have found that the results of our drive to reduce costs have greatly exceeded our expectations. We have proved to ourselves that waste that appears negligible often amounts to a surprising figure and that the sum of a number of small savings may mean the difference between profit and loss for the entire business. More money was spent for this purpose in a depression year than in normal years but this amount already has been repaid through the reduction of costs effected.

MATERIALS HANDLING



Courtesy Link-Belt Company



Courtesy Webster & Weller Manufacturing Companies

Cutting handling costs at the mill of the Puget Sound Pulp & Timber Company, Everett, Wash., is an installation that consists of belt conveyors, belt trippers, chain elevators, transfer table chains, flight conveyors, and a special movable hopper.

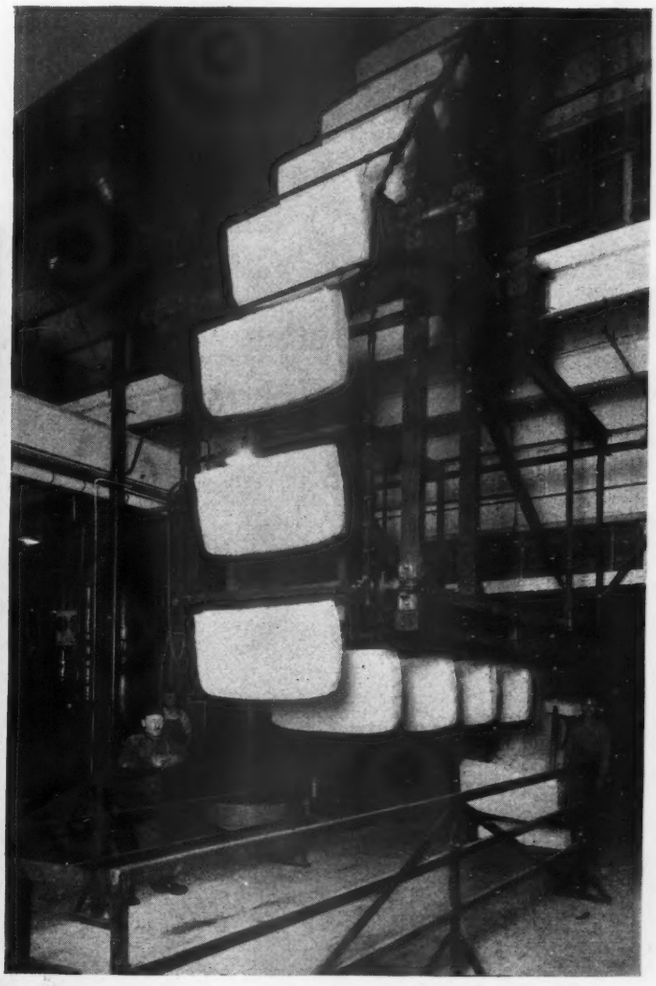
A slat conveyor driven through a variable-speed transmission insures delivery of enamel stove parts from storage to the assembly department of the Standard Gas Equipment Corporation, Baltimore, Md., at the exact rate desired.

In this plant heavy dies are transported quickly between presses and storage by a special 15-ton gasoline-electric tiering truck. The electric winch for raising the platform also is used to slide the dies on and off.

Courtesy The Elwell-Parker Electric Company

In transferring material between two levels, space required by a ramp is saved in the plant of the Weber Lithograph Company, Chicago, Ill., by the use of a stationary, portable-type elevator.

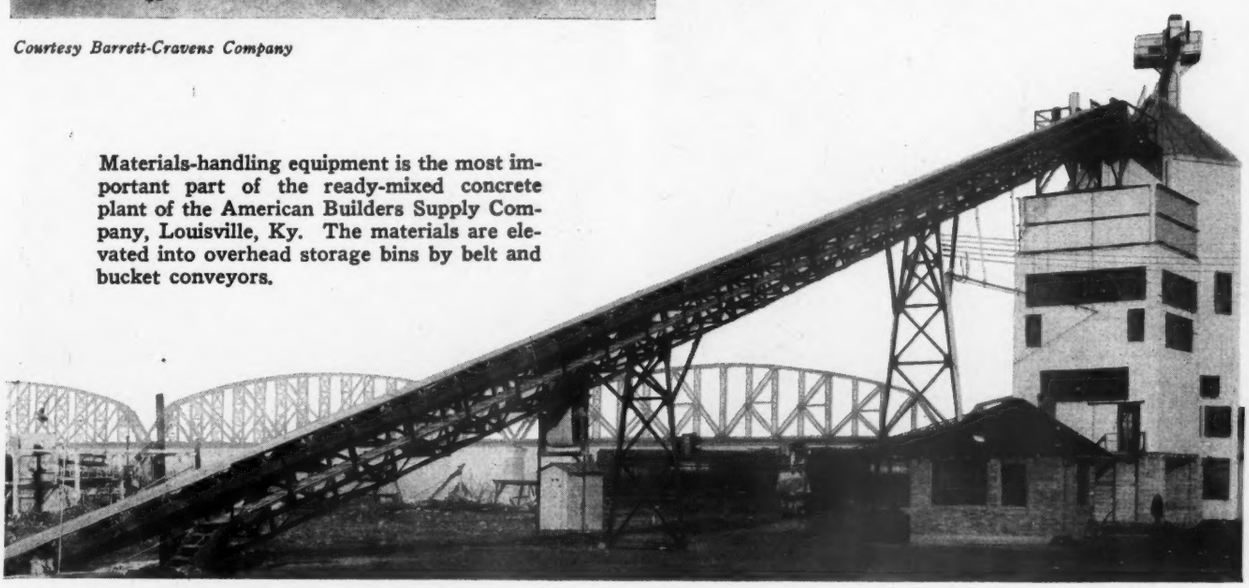
Courtesy Barrett-Cravens Company



Courtesy Mechanical Handling Systems, Inc.

Carrying automobile seat cushions from the first floor of an automobile body plant to the trim department on the seventh floor, this double-chain conveyor has eliminated shortages of materials and cut handling costs.

Materials-handling equipment is the most important part of the ready-mixed concrete plant of the American Builders Supply Company, Louisville, Ky. The materials are elevated into overhead storage bins by belt and bucket conveyors.

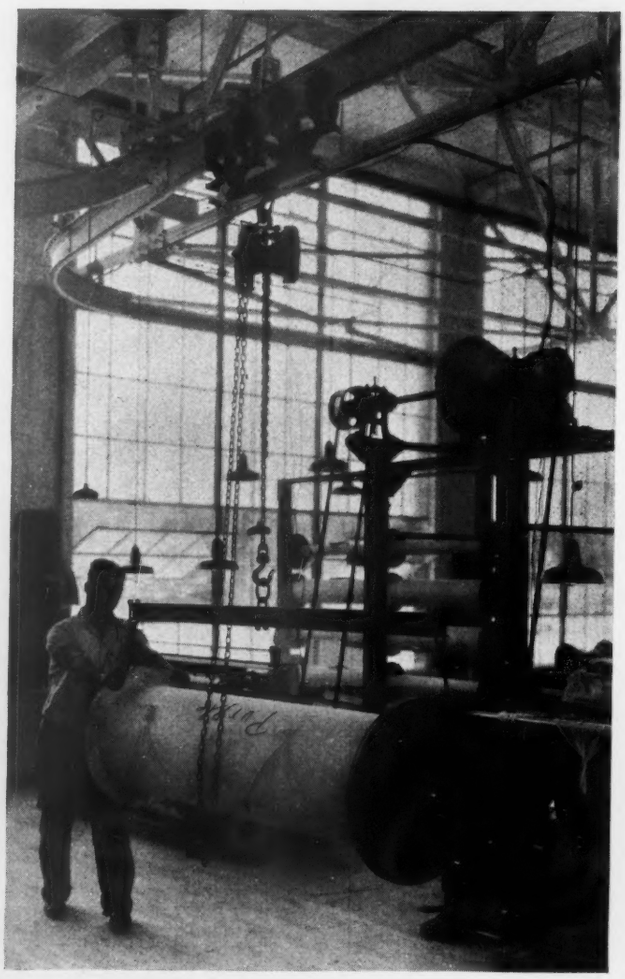


Courtesy Stephens-Adamson Manufacturing Company

MODERN EQUIPMENT AT WORK

Courtesy Trackson Company

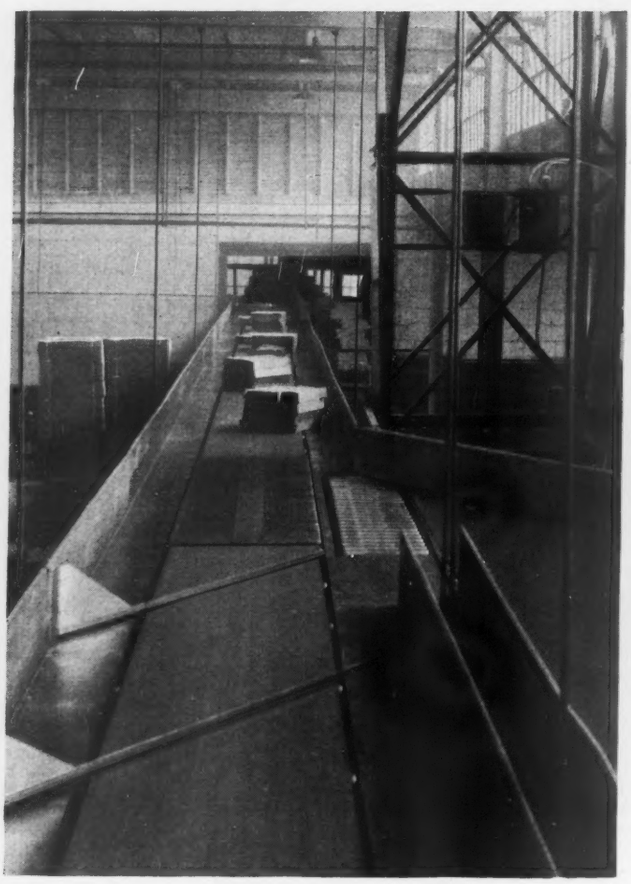
A combination tractor and power shovel that digs, hauls, and loads materials in one continuous operation.



Courtesy The Louden Machinery Company

Heavy yarn beams are handled safely and easily by one man in the plant of the Stillwater Worsted Mills, Augusta Springs, Va., by means of a hoist and trolley running on a monorail track of special design.

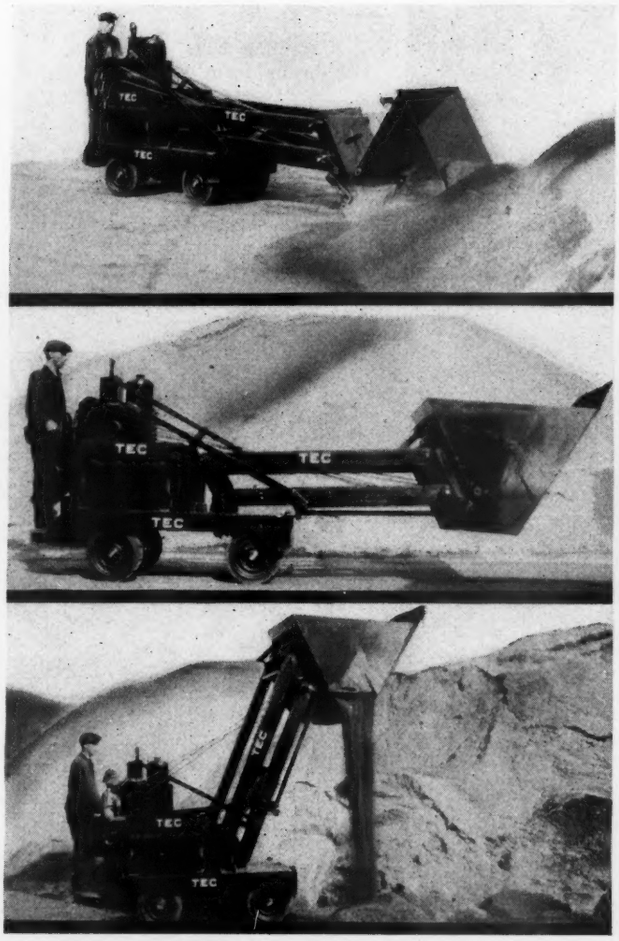
Installation of a conveyor system in the plant of The F. J. Kress Box Company, Pittsburgh, Pa., saved building a 50,000-sq. ft. addition. Here one of the overhead belt conveyors is shown carrying finished cartons to storage.



Courtesy Mathews Conveyer Company

No platform is required when loading and unloading freight cars with this telescopic tiering truck, used by a large manufacturer of photographic supplies.

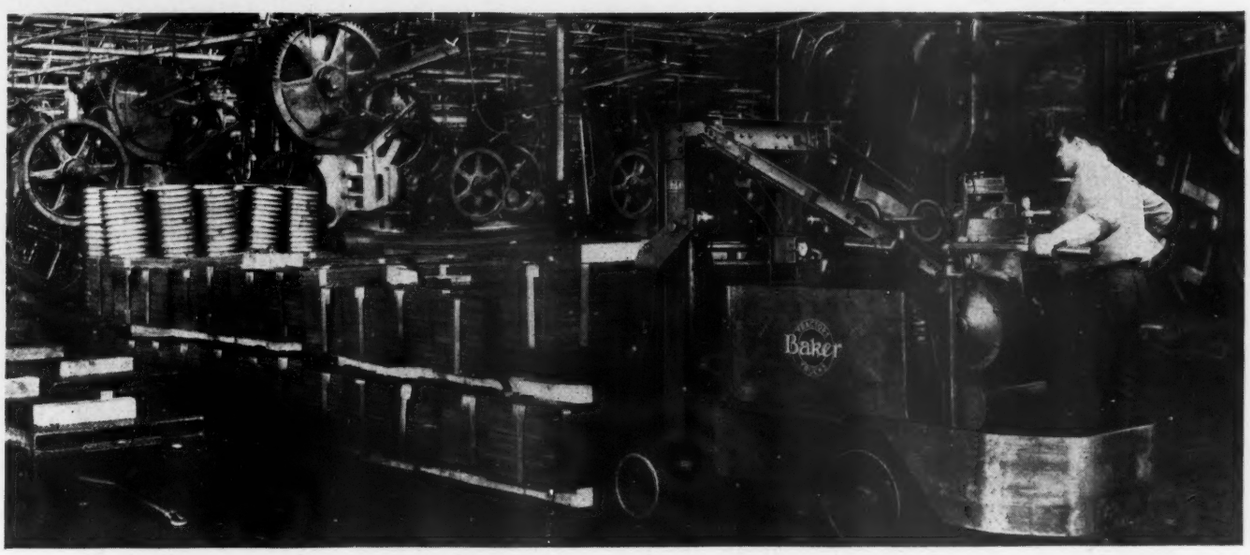
Courtesy Wright-Hibbard Industrial Electric Truck Company, Inc.



Courtesy Terminal Engineering Company

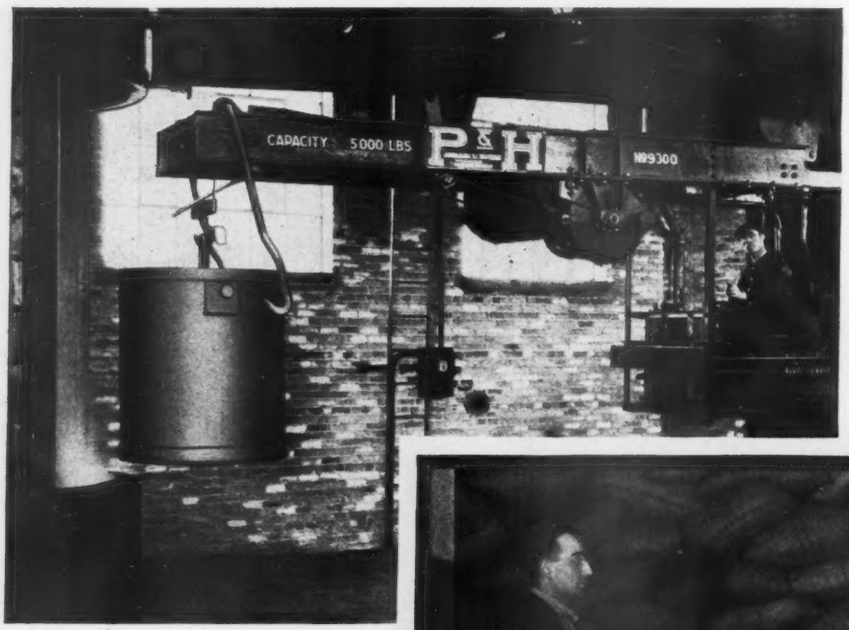
A saving of $80 a day followed the adoption of this boom shovel mounted on an electric truck at the power plant of the National Biscuit Company, New York, N. Y. It scoops up and carries coal from a tunnel to the boiler room.

Here packs of sheet steel weighing 4 tons each are being unloaded from cars and stacked by a 4-ton, fork-type electric truck at a cost of less than two cents a ton.



Courtesy The Baker-Raulang Company

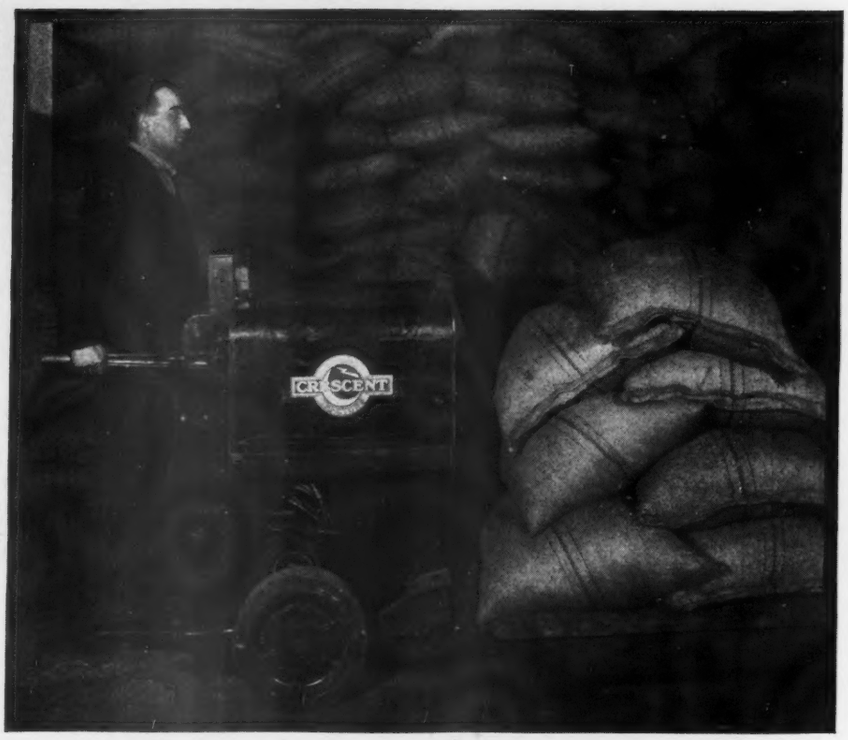
MODERN EQUIPMENT AT WORK



Courtesy Harnischfeger Corporation

Hauling bags of cocoa beans from storage to the roasters of the Hershey Chocolate Company, Hershey, Pa., is one of many jobs handled by electric lift trucks.

Cutting the time and cost of charging a cupola is the function of this special hoist. The loaded bucket is run into the cupola and the charge is dumped as rapidly as desired.



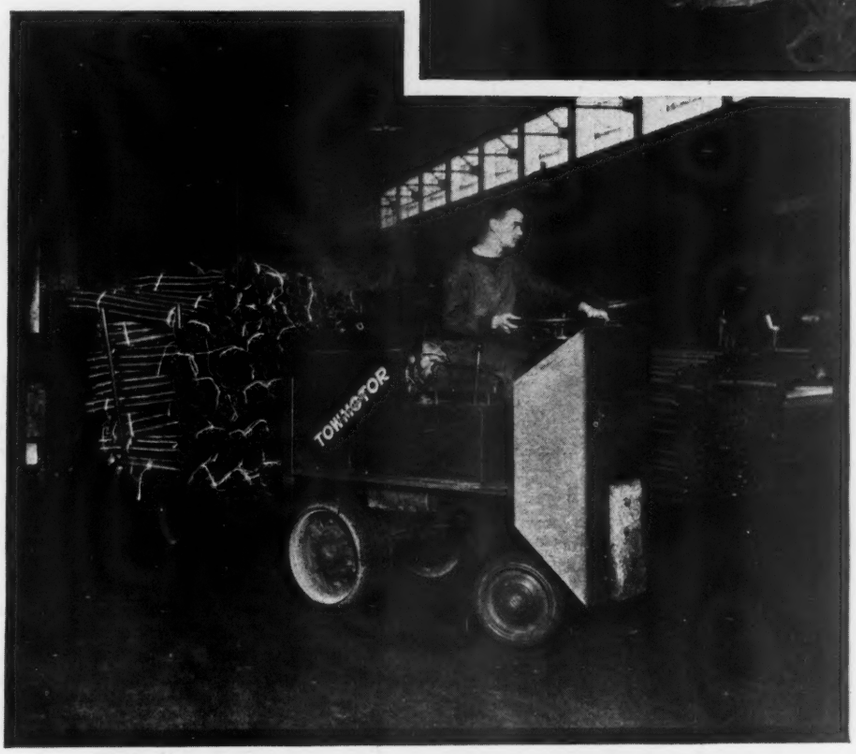
Each of these flexible gravity roller switches serves five oil drum storage lines and carries the drums to the shipping platform, for the Standard Oil Company, Baton Rouge, La.

Courtesy Crescent Truck Company

Courtesy Logan Company

In the cold storage warehouse of Swift & Company, Chicago, Ill., boxes of meat weighing 1,300 lb. are handled and tiered by one man using this hand-power telescoping truck.

Courtesy Economy Engineering Company



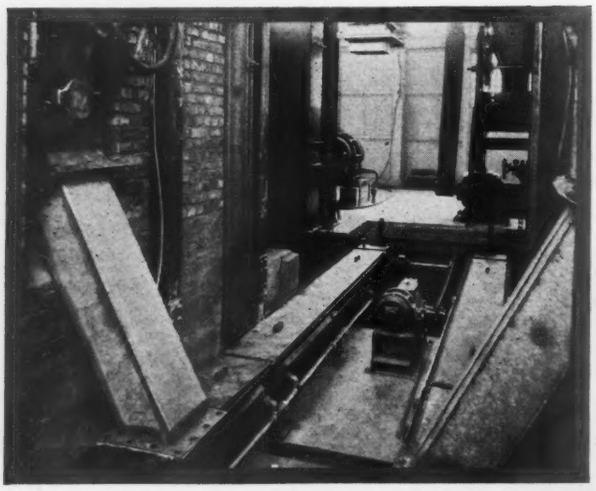
Courtesy The Towmotor Company

A gasoline tractor is an important link in the materials-handling system in the plant of a large manufacturer of steel products.

Part of the 5 miles of conveyor belt in the elevator of the Galveston Wharf Company, Galveston, Tex. These 42-in. five-ply, rubber belts are more than 1,000 ft. long.

Courtesy Diamond Rubber Company

MODERN EQUIPMENT AT WORK



Courtesy H. W. Caldwell & Son Company

Red lead at a temperature of 500 deg. F. is carried from the furnaces to the storage elevator of Hammond Lead Products, Inc., Hammond, Ind., by these 10-in., water-jacketed screw conveyors with dust seal troughs.

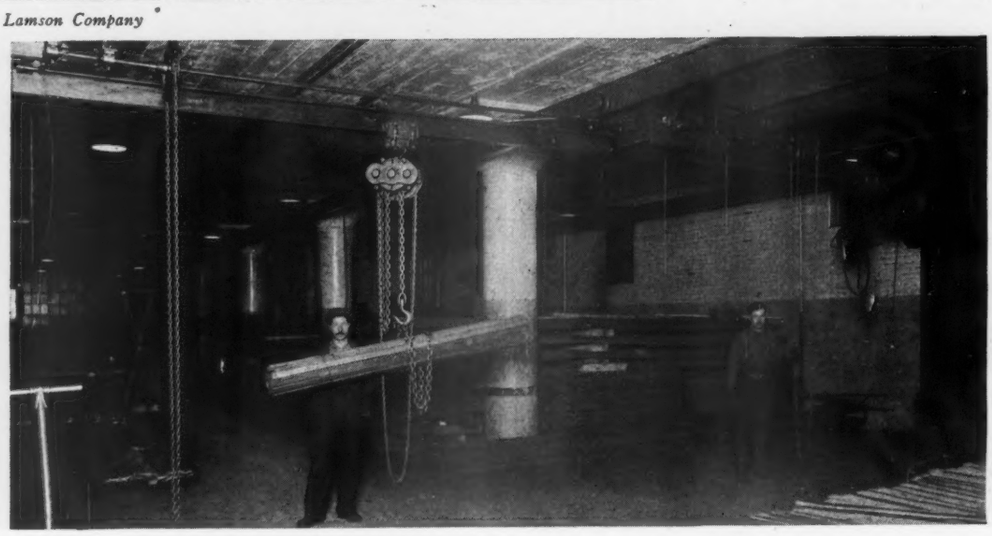
Courtesy Clark Tructractor Company

Bagged material is handled into and out of freight cars at the rate of 30 bags per minute by means of a special portable conveyor.

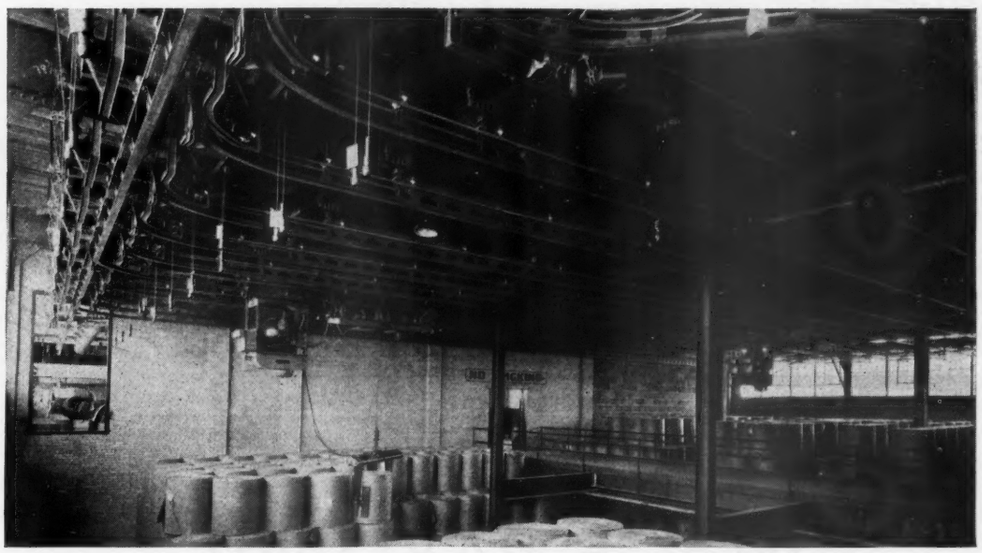
Courtesy The Lamson Company

About 30 per cent of the total cost of a candy bar was saved by the Sperry Candy Company, Milwaukee, Wis., through the installation of this conveyor system. The belt and gravity conveyors carry empty boxes and candy to the packers, and full boxes to the tying machines.

Installation of four 2-ton, underhung, transfer-type cranes resulted in a 60 per cent reduction in the cost of unloading and handling steel in the plant of the Stewart-Warner Speedometer Corporation, Chicago, Ill. Track wheels and trolleys are equipped with roller bearings. The cranes have a 13-ft. span.

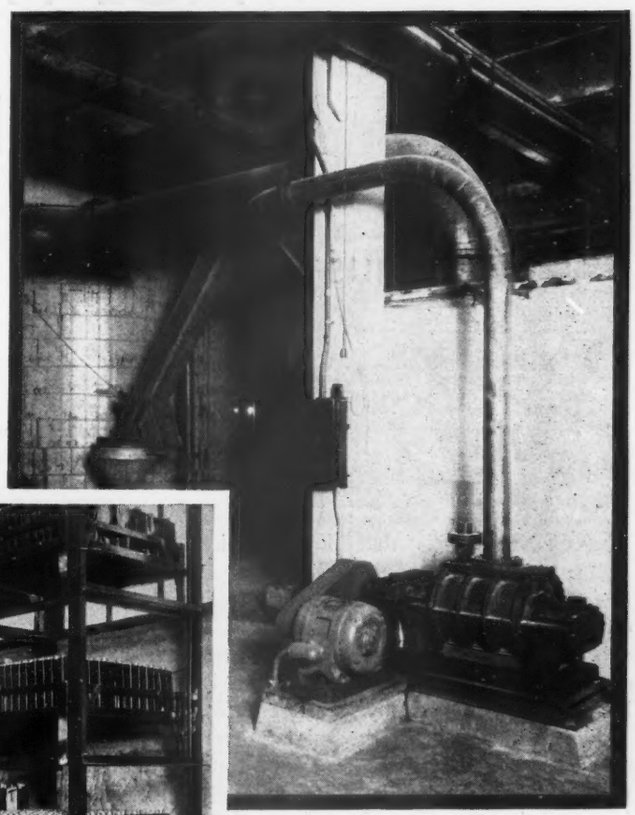


Courtesy Chisholm-Moore Hoist Corporation



Courtesy Cleveland Electric Tramrail

Part of the overhead materials-handling system in the plant of Taggart-Oswego Paper Company, Oswego, N. Y. Rolls of paper are handled by two electrically driven carriers, with a speed of 600 f.p.m. and an electric hoist supporting a motor-operated roll grab.

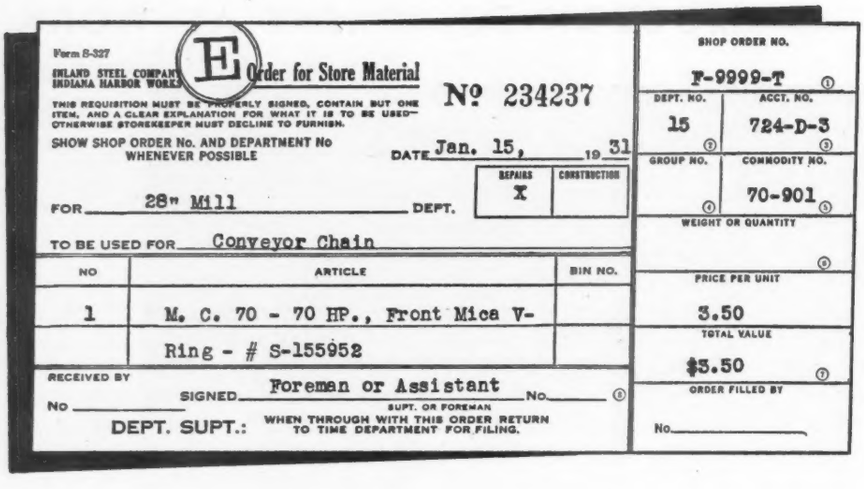


Clean and economical transportation of corn germ is accomplished 24 hours a day at the plant of the Anheuser-Busch Company, St. Louis, Mo., by the use of a pressure-type pneumatic conveyor system. The material is fed through the hopper and rotary air lock at the left. Air pressure is supplied by the rotary blower in the foreground.

Courtesy United Conveyor Corporation

Efficient and economical handling of storage batteries into and out of stock is provided in this plant by a power stacker that piles the skid-boxes four high on a rack, in one-fourth of the storage space formerly necessary.

Courtesy Lewis-Shepard Company



Form 8-327
INLAND STEEL COMPANY
INDIANA HARBOR WORKS

Order for Store Material

Nº 234237

THIS REQUISITION MUST BE PROPERLY SIGNED, CONTAIN BUT ONE ITEM, AND A CLEAR EXPLANATION FOR WHAT IT IS TO BE USED—OTHERWISE STOREKEEPER MUST DECLINE TO FURNISH.

SHOW SHOP ORDER No. AND DEPARTMENT No WHENEVER POSSIBLE

DATE Jan. 15, 19 31

REPAIRS X | CONSTRUCTION

FOR 28" Mill DEPT.

TO BE USED FOR Conveyor Chain

NO	ARTICLE	BIN NO.
1	M. C. 70 - 70 HP., Front Mica V-	
	Ring - # S-155952	

RECEIVED BY
No
SIGNED Foreman or Assistant
SUPT. OR FOREMAN
No
DEPT. SUPT.: WHEN THROUGH WITH THIS ORDER RETURN TO TIME DEPARTMENT FOR FILING.

SHOP ORDER NO. F-9999-T ①
DEPT. NO. 15 ②
ACCT. NO. 724-D-3 ③
GROUP NO. ④
COMMODITY NO. 70-901 ⑤
WEIGHT OR QUANTITY ⑥
PRICE PER UNIT 3.50
TOTAL VALUE $3.50 ⑦
ORDER FILLED BY
No

Fig. 1—Order for store material lists one item only, gives definite information as to its use, and supplies department and accounting identification.

WAGE-PAYMENT MODERNIZATION

A Bonus for Reduction of Maintenance Costs

FRED W. ACKER

Assistant Superintendent Electric and Power Departments
Inland Steel Company, Chicago, Ill.

INCENTIVE is that power which stirs a man's spirit to perform difficult tasks. It stimulates him to put forth additional effort to increase his production if this increase is rewarded by a larger pay check. The only means the average workman has to increase his income is by participating in a bonus which he has helped to earn by his added efforts.

The management of the Inland Steel Company, after careful study, found that an added compensation, in the nature of a cash bonus, when properly applied, would increase the quantity of work produced with a given capital investment. This analysis further proved that when an employee is allowed to increase his income, he cheerfully performs better work.

Our plan is known as the "Cost-Bonus" system, because the bonus is earned by reducing the maintenance costs per ton of steel produced. It was first tried out in the maintenance of the mechanical equipment of the various mills. Later it was revised to combine the maintenance of both the electrical and mechanical equipment.

Our cost-bonus is fair because every member of the maintenance organization participates in its benefits. The division is made on the basis of the quarterly wages paid. For example, a man drawing a salary of $800 per quarter will receive twice as large a bonus check as the man who draws a salary of $400 per quarter. The men receive 50 per cent of the money saved.

The successful operation of this system does not depend on an inspector to check the quality of work performed and also to see that the workman performs a full day's work. If the workman fails to perform his task properly, it will show up in increased maintenance costs.

Therefore, it can be said truthfully that the ambition of the individual workman to earn a large bonus check keeps him from performing "sloppy" work.

The installation of this system was supervised by our efficiency engineer. He divided the plant into divisions corresponding to our Mill Departments. For example, Plant No. 2 Open Hearth constitutes a division. Any earned cost-bonus due to reduced maintenance costs in this division is divided among the maintenance men only. By keeping the divisions relatively small the personal incentive is greater because the men know that their earned

bonus is not affected by any other division's failure to function properly.

The base or maximum maintenance cost to be used in the operation of this system was arrived at by considering the performance during the 18 months previous to the installation of the cost-bonus system to arrive at an average of the maintenance costs necessary to produce a ton of steel for the division.

When the base cost was attained, it was unchangeable. The maintenance men then were informed that at the end of each quarter a percentage of this saving would be shared with them as previously described. The bonus is paid on the average cost of operations for the quarter. This balances high and low cost months and prevents holding over on necessary repairs to obtain a higher bonus rate for any particular month.

The cost-bonus paid the first quarter becomes a part of the maintenance expense of the second quarter, and so on through the year. At first this seems unfair because it will increase the maintenance cost of each quarter and therefore decrease the earned cost-bonus. But this cost-bonus is just as much a paid wage as the regular check and therefore a legitimate maintenance expense.

The "taste" of a monthly cost-bonus has created in each man a desire not only to perform his task in the most efficient manner but to see that his co-workers do not neglect their tasks and thereby cause an unnecessary maintenance expense. This ever alert attitude has prevented many costly repairs and delays in production. Replacement parts which previously were scrapped are being rejuvenated at a very low expense. Worn parts now are removed while they can be repaired or replaced before they inflict costly damage to adjacent parts. Bolts, nuts, and many other parts which formerly were left lying, now are saved and used in preference to issuing a requisition on the stores for new material. In fact, each man watches the spending of his department's money for unnecessary materials as closely as if the money came from his own pocket.

The net result of combining the mechanical and electrical departments under a common bonus plan is that they are more closely tied together by the co-operative spirit of keeping the total maintenance cost low. Carelessness on the part of either department may cause all to lose the bonus for a quarter. If the motor inspector finds that excessive play in the gearing of a drive is causing unnecessary motor repairs, he immediately tells the mechanical man, because the latter is vitally interested in keeping the electrical maintenance cost low. This mutual co-operative spirit has practically eliminated the personal friction between the two departments, thereby increasing the morale of the maintenance department as a whole.

The benefit of this system is best shown in the results it has accomplished. It has been in operation for three years and has reduced our maintenance costs approximately 30 per cent in addition to increasing our output by reducing the number of productive delays.

Our Organization

We believe the cost-bonus system of our plant is worthy of careful study. A brief description of our plant organization will provide a background against which to study the system.

Under normal conditions, approximately 7,500 men

DO NOT WRITE IN THIS MARGIN

1 2 3 4 5 6 7

INLAND STEEL COMPANY
INDIANA HARBOR WORKS
DATE Dec. 21, 1930

NO. 576 NAME John Wilson OCCUPATION Motor Inspector

All mechanics and helpers are required to fill out time slips and deposit same in the office of their shop before leaving the plant. Write plainly a description of the work done and show the shop order number. Be careful to charge up the correct time worked on each job and do not charge to more than one department on a coupon.

Total time for this date amounts to 8 Hours None Minutes

Distributed below.

Signed Ed. Hendron, 40" Blooming Mill
Shop Foreman

NOTICE: NEVER CHARGE MORE THAN (1) ONE DEPARTMENT ON A COUPON.

DESCRIPTION OF WORK (Coupon 1)	Construction or Repairs	DEPARTMENT	HRS.	MIN.	ORDER NO.	ACCOUNT	AMOUNT
Removed Soaking Pit Crane Trolley Motor	REPAIRS	40" Mill	4	45		724-D-3	$3.80
DESCRIPTION OF WORK (Coupon 2)	**Construction or Repairs**	**DEPARTMENT**	**HRS.**	**MIN.**	**ORDER NO.**	**ACCOUNT**	**AMOUNT**
Inspected Billet Dock Crane Motors	REPAIRS	~~Billet~~ Mill	2	15		720-D-5	$1.80
DESCRIPTION OF WORK (Coupon 3)	**Construction or Repairs**	**DEPARTMENT**	**HRS.**	**MIN.**	**ORDER NO.**	**ACCOUNT**	**AMOUNT**
Cleaned Contacts On Screw Down Control	REPAIRS	40" Mill	1	00		724-D-3	$0.80
DESCRIPTION OF WORK (Coupon 7)	**Construction or Repairs**	**DEPARTMENT**	**HRS.**	**MIN.**	**ORDER NO.**	**ACCOUNT**	**AMOUNT**

Form T 497 100M 7-29

Fig. 2—Maintenance department time slip. On the seven coupons the time applied to specific jobs is recorded. Each coupon must show time charged to a single department only.

Form T 297 1M 12-30

SUMMARY OF PLANT No. 2 ELECTRICAL DEPT.

Date

	1ST TURN	2ND TURN	3RD TURN	
Asst. Chief Elect.				
TOTAL				
BLAST FURNACE				
Elect. Foreman				
Motor Inspector Furnaces				
Motor Inspector Furnace Helpers				
Dock Motor Inspector Foreman				
Dock Motor Inspector Ore Bridge				
Dock Motor Inspector Helper				
Handyman				
Electric Utility Man				
TOTAL				
OPEN HEARTH				
Elect. Foreman				
Floor & Pits Motor Inspector				
Floor & Pits Motor Inspector Helpr.				
Scrap Yd. Motor Inspector				
Scrap Yd. Motor Insptr. Hlpr.				
TOTAL				
14 IN. MERCHANT MILL				
Electric Foreman				
Motor Room Drive Operator				
Motor Inspector				
Motor Inspector Helper				
TOTAL				
40-32-28 IN. MILLS				
Elect. Foreman				
40-in. Motor Insptr. Pits				
40-in. Motor Insptr. Helpr. Pits				
Rail Mill Motor Insptr.				
Electric Supply Chaser				
TOTAL				
COKE PLANT				
Elect. Foreman				
Battery Motor Insptr.				
Lamp Trimmer				
TOTAL				
CONSTRUCTION & REPAIRS				
Elect. Foreman				
Wireman				
Lineman				
Lineman Helpers				
Lamp Trimmers				
TOTAL				
MISCELLANEOUS				
Motor Room Foreman				
Motor Insptr.				
Motor Insptr. Helpers				
TOTAL				
TOTAL				
GRAND TOTAL				

SUMMARY OF PLANT No. 2 ELECTRICAL DEPT.

Fig. 3—A daily personnel summary by department is necessary in regulating the size of the organization to match the output of steel. A similar form is used for the departments in Plant No. 1.

are employed. By-product coke is produced from 278 ovens for use in 4 blast furnaces and for outside trade. Two open-hearth plants, one having 12 furnaces and the other 15 furnaces, provide the steel for the two blooming mills. The finished products are pig iron, billets, sheets, bars, rounds, plates, bolts, rivets, rails, spikes, and structural shapes.

The men in the electrical department are divided into three groups, namely, construction, maintenance, and repairs. They are governed by the Superintendent of Electrical and Power Departments.

A foreman is in charge of the men operating and maintaining the main drive equipment in all mills. Each mill is given an electrical foreman and a staff of motor inspectors and helpers to maintain the auxiliary electrical equipment in that mill. This mill electrical foreman, even though he is governed by the electrical superintendent, is responsible to the superintendent of the mill for continuous operation and low maintenance costs. He and his men must work for the low maintenance which provides their cost-bonus checks.

The repair shop reports direct to the superintendent of electrical and power departments. It repairs all motors and performs such repairs on control parts as cannot be performed by the men in the mill. The repair shop works on the incentive plan which will be discussed in a later issue.

Orders for Maintenance Materials

Requisitions for repair parts and other maintenance materials to be used in the mill originate with the electrical foreman in the mill. His requisitions, Fig. 1, carry the necessary data for the stores, if the material is carried in stock or is to be purchased. Requisitions for material not carried in the general stores must be sent to the electrical superintendent's office for his approval before stores place the order with the purchasing department.

Distribution of Time

The maintenance and construction departments use a time slip, Fig. 2, which provides space for seven coupons, to show the work performed, time in hours and minutes, order number, account number, and wages per coupon. Each coupon is used to show the time required and the work performed for a specific department. If a workman's time is divided among three departments he fills out three coupons.

The next day these coupons are cut apart and are grouped according to departments, after which they are returned to the respective superintendents of the departments charged for their work for checking. Any corrections are noted on the coupons, by the superintendent of that mill, after which he signs and returns them to the time department. In this manner the superintendent of a department involved can question any work charged against him while it is fresh in the minds of those affected. It affords the department superintendent the privilege of knowing exactly what is charged to his account for maintenance.

Personnel Summary

Each morning the electrical superintendent has placed on his desk a personnel summary for the electrical de-

Fig. 4—Good inspection is the secret of low maintenance costs. The inspector's report provides a daily summary of each inspector's activities and a list of the equipment he inspects.

INLAND STEEL COMPANY

ELECTRICAL DEPT — INSPECTOR'S REPORT January 22, 1931

DEPT.	DOWN	STARTED	MOTOR DRIVING	REPAIRS MADE	DELAY
40" Mill	8:45	8:50	No. 1 Mill Table	Replaced Brushholder	5 Min.
30" Mill			Screw Down	Cleaned Mica V-Ring. Inspected Bearings	No Delay
30" Mill			Runout Table	" " "	No Delay
Billet Mill			Trolley Motors No. 2 Crane	General Inspection	No Delay

REMARKS: 30" Mill Runout Table Motor Running hot. Suggest Mech. Dept. investigate possibility of Rolls Being out of Allignment causing overload.

CRANE LIMIT SWITCHES

1	2	3	4	5	6	7	8	9	10
Yes	Yes		Yes		Yes				

FIRE EXTINGUISHERS

Yes	Yes		Yes	Yes	Yes	Yes			

REMARKS:
Twisted Motor on Soaking Pit Crane No. 1 running hot. Suggest Test Engineer make load test.

Commutating Field Coil is loose in Trolley Motor on No. 2 Billet Dock Crane.

George Hansen
INSPECTOR

Fig. 5—The stores inventory may be kept to a minimum by using a record card which provides a daily quantity balance and its values and the necessary data for determining the maximum and minimum points for ordering. Articles having a high daily inventory value must be given very careful study to provide adequate protection with reduced maximum and minimum points for ordering.

ARTICLE: S#-142388-A ARMATURE COILS (35 Per Set) — COM. NO. 22-0390

For Westinghouse M. C. 70, 70 HP., Serial No. 1992953 — UNIT Each

LOCATION	BIN NO.	WHERE STORED	TIME REQ. FOR DELY	QTY. TO ORDER	ORDER POINT
	719	Gen. Stores	7 Days	525	210

DATE	REQ. NO. AND ORD. NO.	QUANTITY ORDERED	UNIT PRICE	QUANTITY RECEIVED	DATE	QUANTITY ISSUED	QUANTITY BALANCE	VALUE
					4-9-29	70	210	840.00
4-9-29	H-5942	525	$4.00	525			735	2940.00
					4-21-29	70	665	2660.00

partment for the previous day. See Fig. 3. This summary is necessary in order to give him a picture of the size of his organization from day to day. It is of great value in regulating the size of the organization with the output of the mill.

Inspection Report

Good inspection is the secret of low maintenance cost. Each morning at 8 o'clock the electrical mill foreman receives a daily "inspector's report," Fig. 4, from each motor inspector. It covers the condition of the equipment under his care and shows what repair work he performed during his shift.

The electrical superintendent receives a summary inspection report from his respective mill foreman by 11 o'clock. It covers the high points of the motor inspector's reports, giving him an opportunity of knowing what has transpired in the past 24 hours.

Stores

The electrical stores come under the general supervision of the Chief Store Keeper, who has under his employ a competent man familiar with the details of ordering electrical equipment. We believe this method to be preferable to that of having the stores department directly under the electrical department. In some instances, which in our opinion are very rare, the electrical department might be justified in carrying a sub-storeroom under its supervision, for outlying departments. Since the chief duty of the storekeeper is to keep on hand at all times supplies required to operate and maintain a plant, he is in better position to handle orders, make claims, and settle adjustments than is the electrical department. The superintendent of electric and power departments must approve all requisitions.

In order that the stores inventory may be kept to a minimum at all times, we have established a maximum and minimum point method of ordering commodities. This is set at 30 days for fast-moving items and 90 days for slow-moving items.

There is shown in Fig. 5 a simple stores record card having ample space at the top for a complete description of the part to be ordered, quantity to be ordered, commodity number, unit, bin number, date, order number, quantity received, date issued, quantity issued, balance on hand and its value at inventory. The ordering point is the minimum to which this store is permitted to drop, which on this card is set at 210. The 525 (quantity to be ordered) plus the 210 (ordering point) gives a maximum on hand at any time of 735, for this particular item.

A close and efficient check is kept on stores at all times and an inventory is taken every 30 days. This procedure permits a minimum which is consistent with efficient handling of the commodity involved and permits scrapping or disposing of excess stock which may become obsolete or damaged. The scrapping program is efficient and easily handled because it is easier to charge off small amounts each month than large amounts at the end of the year.

[In the second article, to be published next month, the author follows a job through the electric repair shop.]

LIGHTING

Courtesy The Miller Company

No danger of getting lost or stumbling over piles of steel at night in the well-lighted storage yard of The Emsco Derrick & Equipment Company, Los Angeles, Calif. High-mounting units provide the illumination.

■ ■

Lowering the lighting units for cleaning or replacement of bulbs eliminates danger and speeds up the work of servicing in the train shed of the New York Central Railroad, Toledo, Ohio.

Courtesy The Thompson Electric Company

White ceilings and walls help the 500-watt lamps in high-mounting-type reflectors to produce 14 foot-candles of illumination in the plant of the Russell Grader Company, South Bend, Ind. Units are spaced on 20-ft. centers 27 ft. above the floor.

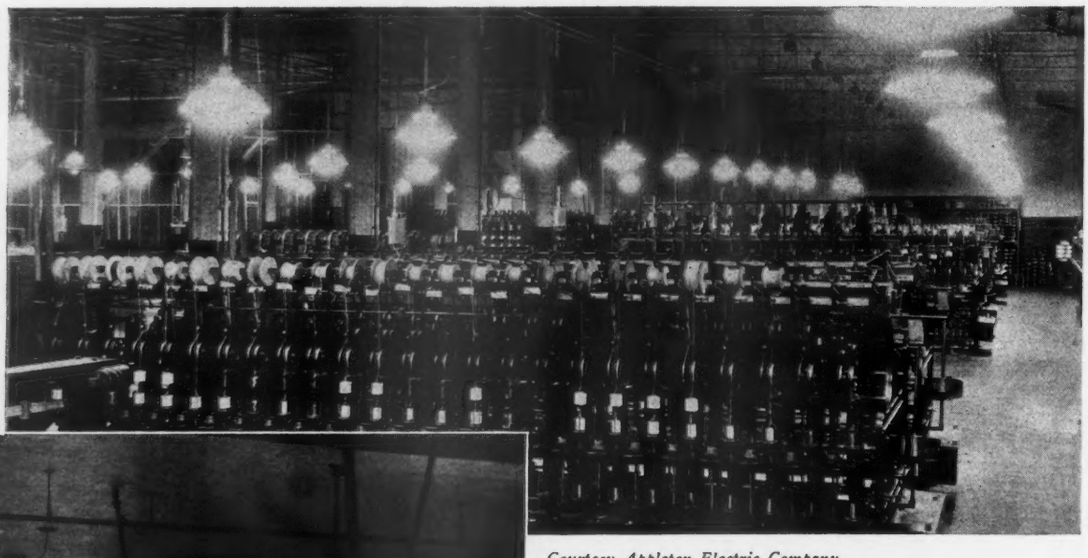
■ ■

Gabriel Manufacturing Company, Cleveland, Ohio, obtains 18 foot-candles of illumination on the working plane of a section of the plant from 300-watt Mazda lamps in diffusing units spaced on 10x12-ft. centers 12 ft. above the floor.

Courtesy Westinghouse Lamp Company

Courtesy General Electric Company

MODERN EQUIPMENT AT WORK



Courtesy Appleton Electric Company

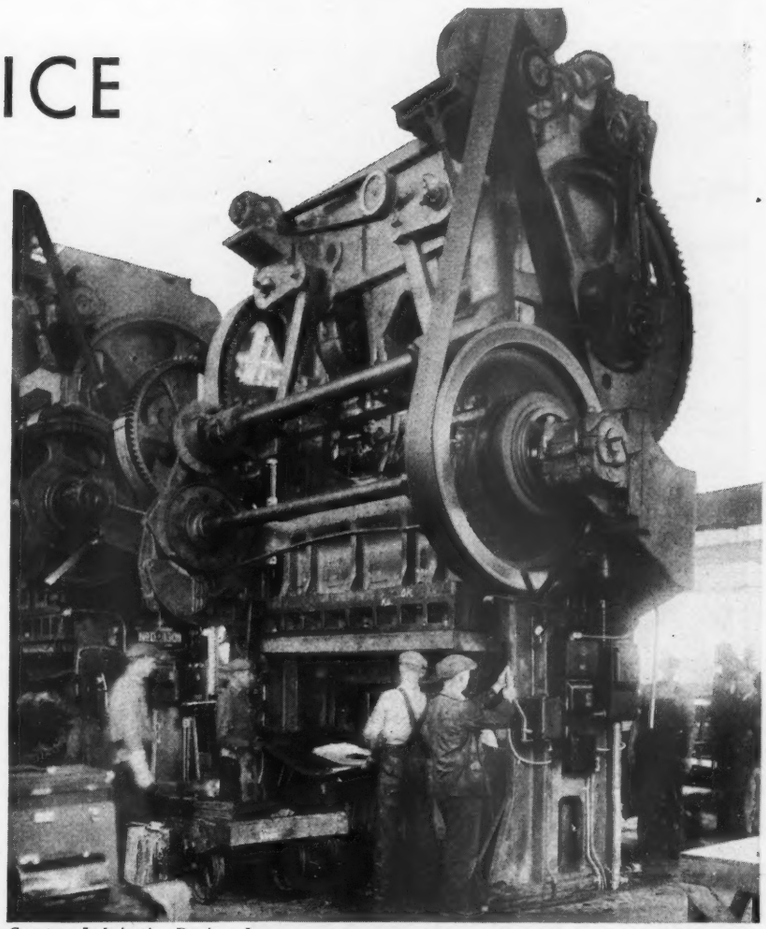
Repair or adjustment of textile machinery is facilitated by the use of portable lighting units which are suspended from special reels and supplement the regular lighting equipment. By such means light can be brought to any point on the machines.

Dark days bring no eyestrain to the draftsmen in the engineering department of Kearney & Trecker, Milwaukee, Wis. In addition to the regular lighting system, each drawing board is equipped with a universal lighting unit adjustable to any desired position, angle, or height.

Modern high-intensity illumination in the plant of the Hoover Company, North Canton, Ohio, plays no small part in promoting high efficiency on the part of the workers.

Courtesy General Electric Vapor Lamp Company

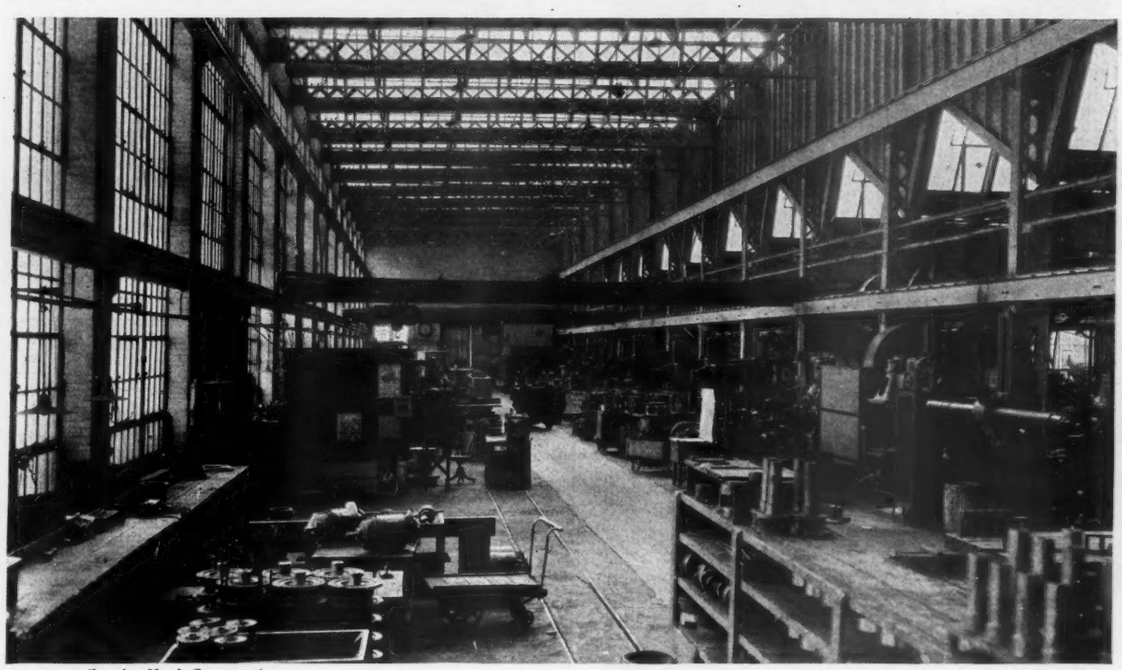
SERVICE



Courtesy Lubrication Devices, Inc.

Modern lubricating equipment has relieved operators of large presses from long and tedious greasing jobs. At the plant of the City Auto Stamping Company, Toledo, Ohio, a central lubrication system takes care of 92 points on a toggle press in less than two minutes.

One floor-mounted unit heater, at the right, distributes heat so evenly through a machine shop that employees are always comfortable, even when working at the bench along the windows.

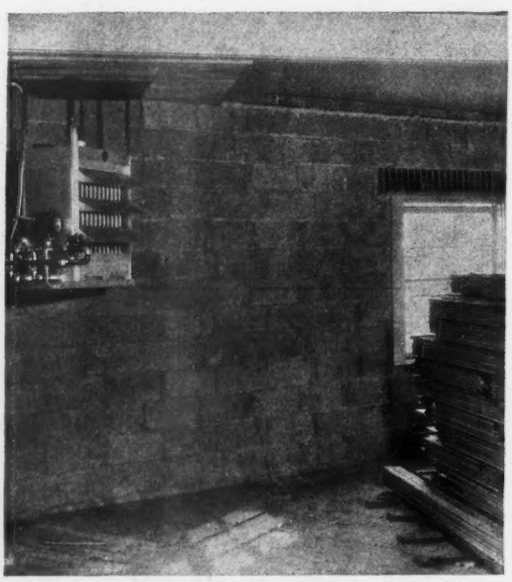


Courtesy Carrier-York Corporation

Courtesy BullDog Electric Products Company

Compressor motors of electric refrigerators are tested as they move along the last 80 ft. of the assembly conveyor in the plant of the Kelvinator Corporation, Detroit, Mich. The motors receive power through cords suspended from trolleys, which travel along and make contact with busbars mounted in a special type of overhead duct. When the trolleys reach the end of their travel they are returned to the head of the line along the back track by gravity.

Here is a gas-fired unit heater doing an unusual job at the Crafton Lumber & Supply Company, Crafton, Pa. Lumber is dried by the continuous circulation of the warm air.

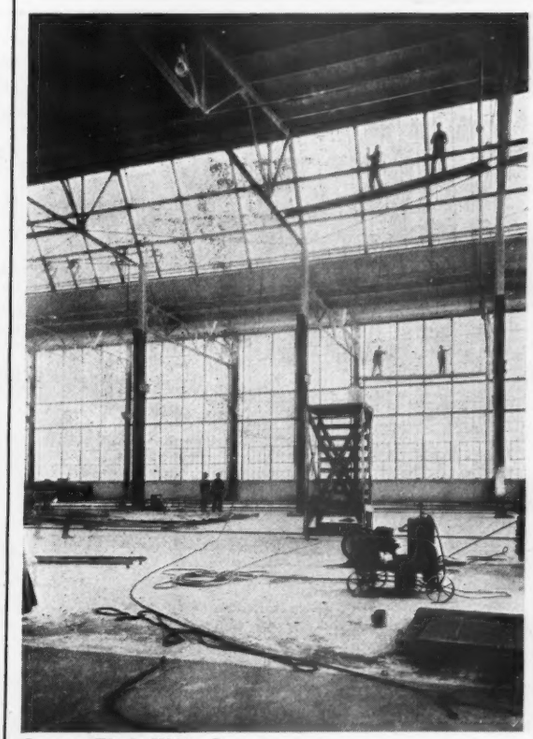


Courtesy Automatic Gas-Steam Radiator Company

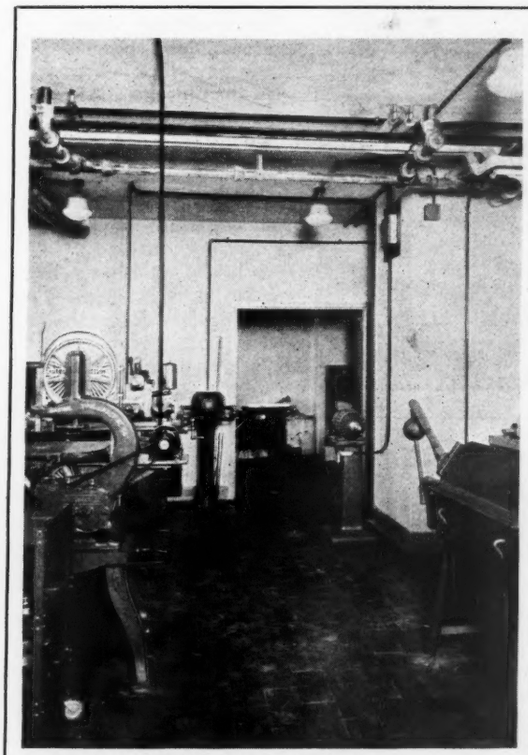
Courtesy Alemite Corporation

Lubricating bearings under the cooling bed of the 10-in. merchant mill in the Inland Steel Company's plant, Indiana Harbor, Ind. The flexible hose with control valve is attached to a pipe line through which lubricant is pumped at 2,500-lb. pressure by a centrally located compressor. Pipe line has a number of outlets from each of which equipment within 20-ft. radius is serviced.

Up among the roof trusses and everywhere else, surfaces that are difficult to reach with a brush can be painted quickly and easily with a spray-painting outfit.



Courtesy The DeVilbiss Company



Courtesy Wright Rubber Products Company

Rubber block flooring is used in this machine shop because of its wear-resisting, noise-eliminating, and shock-absorbing qualities.

Circulation of humidified air in the plant of the American Cigar Company, Louisville, Ky., by means of an air-conditioning system not only keeps the moisture content of the tobacco at its correct value, but also maintains healthful working conditions.

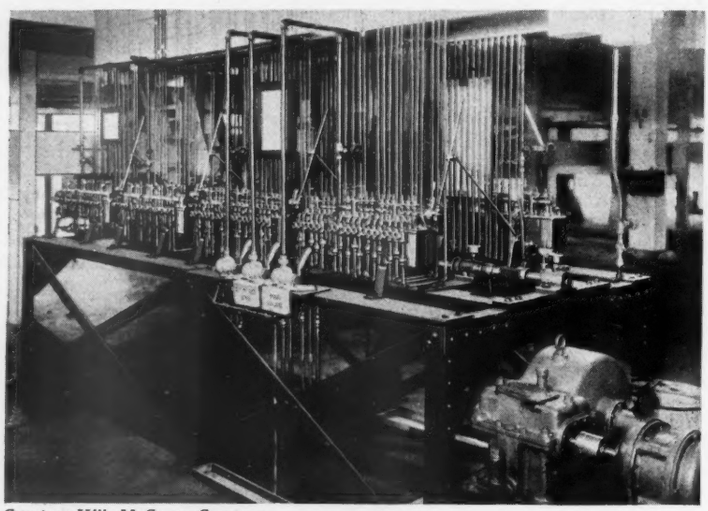
Courtesy Carrier Engineering Corporation

MODERN EQUIPMENT AT WORK

Courtesy Lyon Metal Products, Inc.

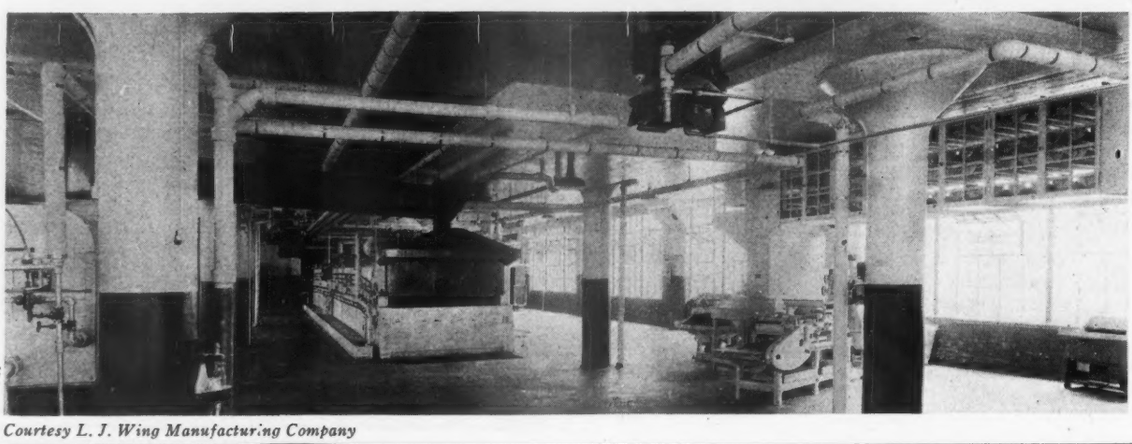
Neat, orderly, easily accessible — that is the way stock is kept in the Chicago stockroom of the Norton Company.

Here there is no chance of forgetting to oil some of the bearings. Machinery scattered throughout a sawmill is oiled by a force-feed lubrication system through 102 feeds assembled in 8 multiple-feed units at the central control point.



Courtesy Hills-McCanna Company

Unit heaters in the plant of the Almar Warehouse & Bakery, Philadelphia, Pa., maintain the desired temperature within narrow limits. Floors and walls are kept clear by suspending the units from the ceiling.



Courtesy L. J. Wing Manufacturing Company

EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

Cutler-Hammer Across-The-Line Starter

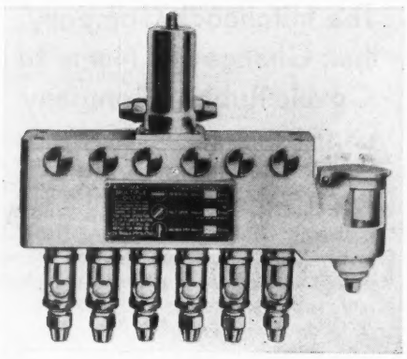
A THREE-POLE, across-the-line type, manual starter for all types of a.c. squirrel-cage motors up to 2 hp. has been announced by Cutler-Hammer, Inc., 253 North 12th St., Milwaukee, Wis. The thermal overload relays operate directly on the contact mechanism and open all three poles on an overload. These overload relays use the same heater coils as other starters and are interchangeable with them. The twin-break contact mechanism gives a double break in each line when opening the circuit. Contacts are silver-to-silver.

The cover interlock prevents the opening of the inclosing case when the motor is running. Overall dimensions are $4\frac{7}{16}$ in. wide, $8\frac{9}{16}$ in. high, and $3\frac{7}{8}$ in. deep.

■

Gits Automatic Multiple Oilers

AUTOMATIC multiple oilers have been announced by Gits Bros. Manufacturing Company, 1846 South Kilbourn Ave., Chicago, Ill. Oilers are designed to lubricate any number of bearings at any desired interval. In operation, oil cups raise out of a well of oil at fixed intervals and drain by gravity through their corresponding outlet tubes. They may be actuated pneumatically, electrically, mechanically, or manually, a suitable timing control



being provided for each type of power unit. Cups may be adjusted to drain from ¼ to 10 drops of oil. Oiler bodies are of aluminum with brass fittings. The illustration shows a six-outlet, pneumatically operated unit.

■

Turner "Blotorch"

DEVELOPMENT of the No. 30-A "Blotorch" has been announced by The Turner Brass Works, Sycamore, Ill. It features a 1-qt., seamless brass tank finished in dull satin, a composition valve handle, a needle designed to prevent enlargement of the orifice, and a completely inclosed pump.

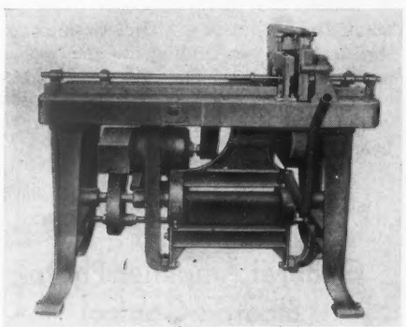
Mundet Adopts Sales Name

ANOUNCEMENT has been made by L. Mundet & Son, 461 Eighth Ave., New York, N. Y., that hereafter its selling organization will be known as Mundet Cork Corporation to link definitely the name and principal product.

■

Campbell Cut-Off Machine

ANDREW C. CAMPBELL, INC., Bridgeport, Conn., announces a cut-off machine known as Model 30, which, according to the announcement, will cut materials of certain character-



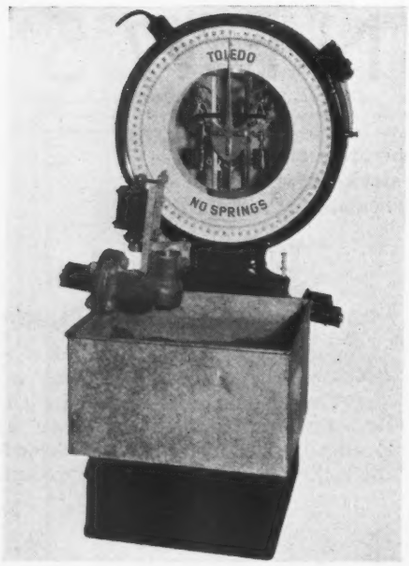
istics up to 1 in. thick and 16 in. wide at the rate of 2 to 12 sec. per cut. The machine also is said to cut such materials as nickel silver, soft iron, and hardened, high-speed steel up to ¾ in. thick and 6 in. wide.

An abrasive disk is used for cutting extra wide stock. The travel arm is arranged so that the spindle travels parallel to the top of the table without the use of slides. Other features are pushbutton control, straight-edge for locating the work, adjustable clamps, welded-steel guards, and V-belt spindle drive.

■

Toledo Dripless Valve

TOLEDO Precision Devices, Inc., Toledo, Ohio, a subsidiary of Toledo Scale Company, announces the development of a solenoid-operated dripless valve. When the current is on, the valve is open and, when the current is



broken, the valve closes. The valve seat is placed at the outlet so that no liquid can flow after the valve is closed. Valves are designed for liquid filling or mixing applications in which exact weights are essential. They are available in ½-, 1-, and 2-in. sizes.

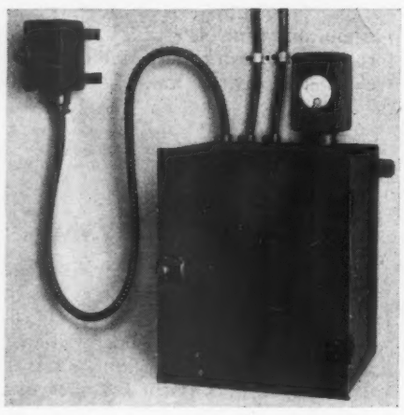
The illustration shows an application in which the valve is closed instantly when the indicator reaches a point on the scale corresponding to the predetermined weight. The valve current is cut off by the action of a photo-electric cell when the indicator intercepts a beam of light.

■

General Amplifier Photo-Electric Control

GENERAL Amplifier Company, 27 Commercial Ave., Cambridge, Mass., announces an instrument designed to amplify the current of the photo-electric cell and to utilize the amplified current to operate the contacts of a sensitive electromagnetic relay.

Amplifier and relay are housed in a standard service box, while the cell is mounted separately in its own housing, being connected to the remainder by a 10-ft. connection cable. The instrument is designed for operation on 105- to 120-volt, 50- to 60-cycle, a.c. circuits. In case of larger current, an auxiliary relay should be employed. The milliammeter shown is not furnished regularly but can be supplied if desired.



■

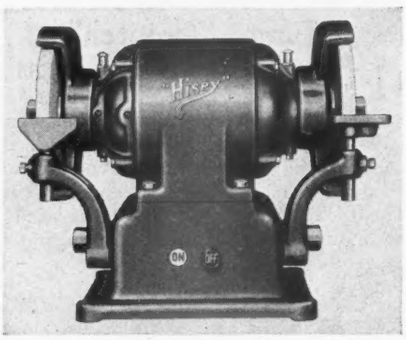
The Hitchcock Company, Inc., Changes Its Name to Covulc Rubber Company

ANNOUNCEMENT has been made by the company formerly known as The Hitchcock Company, Boston, Mass., that it has changed its name to the Covulc Rubber Company, Norfolk Downs, Mass. Also, the general offices will be moved from Boston to the plant at Norfolk Downs.

■

Hisey-Wolf Grinder

THE HISEY-WOLF Machine Company, Cincinnati, Ohio, announces that all its single-phase grinders up to 2 hp. now are equipped with commutating-type, repulsion-induction motors to comply with the more stringent electric codes of many localities. According to the announcement, grinders now draw less starting current and are permitted to operate on lower voltages than formerly. A 6- and 7-in. wheel grinder is shown.

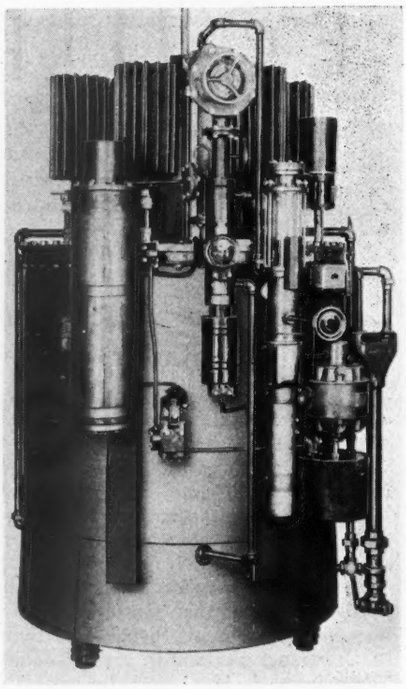


■

Westinghouse Mercury-Arc Rectifiers

MERCURY-ARC rectifiers which convert alternating to direct current over wide ranges of both voltage and current have been announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Although generally used in supplying power for electric traction systems, the equipment has certain industrial applications. For example, in some electrochemical processes, the power requirements are such that rectifiers provide the preferable means of conversion.

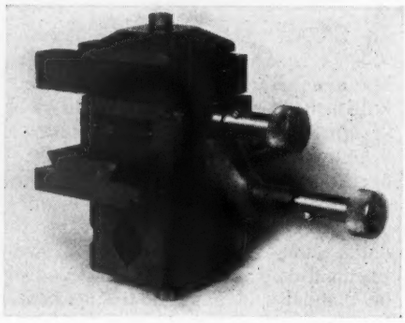
Rectifiers consist of a mercury pool cathode and an anode inside a steel tank, with facilities for condensing the mercury vapor and the necessary auxiliary apparatus for maintaining the vacuum and temperature conditions of the rectifier within the proper limits. The illustration shows a 500-kw. unit.



■

Ideal "Midget" Precision Grinder

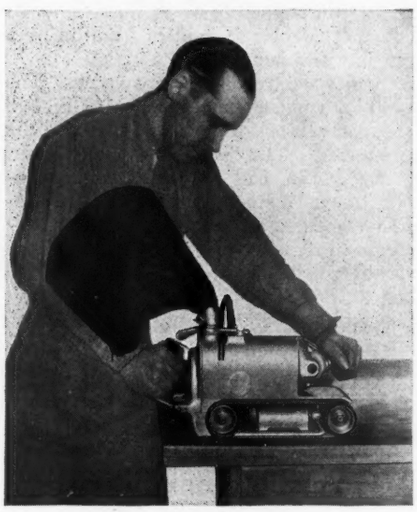
IDEAL Commutator Dresser Company, Sycamore, Ill., announces a precision grinder, known as the "Midget" model, designed especially for use on small commutators having a face width of 8 in. or less, as well as for medium size sliprings. The grinder is of the same general construction and has the same features as the two larger models. A carrying case is included with each grinder.



Porter-Cable-Hutchinson Dustless Sander

DUST removal is accomplished by a vacuum system in the Type B-10 dustless take-about sander, announced by the Porter-Cable-Hutchinson Corporation, Syracuse, N. Y. The double-blade fan draws the dust through ports directly in back of the rear pulley and deposits it in the bag. The bag may be detached from the machine by a twist of the coupling.

Construction features include a 1-hp. universal motor, hardened and ground worm-thread, nickel-bronze worm and spiral gears, eleven ball bearings, sanding shoe covered with cork and tempered steel, and aluminum exposed parts.



Materials other than wood may be surfaced by equipping the machine with a suitable abrasive belt.

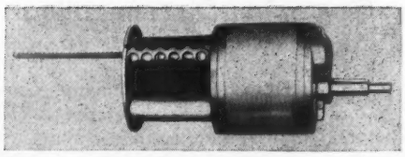
A bench stand can be furnished with the sander which converts it into an edge sander or grinder. The stand supports the unit so that the belt runs free. When in this position work is applied to the belt.

■

Wyzenbeek Universal Speed Saw

A SAWING and filing attachment for use with a portable electric drill is being marketed by Wyzenbeek and Staff, Inc., 566 Washington Blvd., Chicago, Ill. This device may be applied to a flexible shaft unit. Saws are provided for cutting both wood and metal, or the unit can be used with ¼-in. square or round files. A standard ¼-in. electric drill has ample power for the work that the saw can do.

Rotary motion of the drill shank is converted into reciprocating motion of the saw blade through a cylindrical, grooved cam and a hardened steel roller follower. The reciprocating saw plunger



runs in grease-lubricated bronze bearings. The entire mechanism is inclosed in a cadmium-plated knurled housing which is grasped in the hand and is used to guide the saw or file. This outfit includes a complete sawing unit, five additional saw blades and ¼-in. chuck for holding files.

■

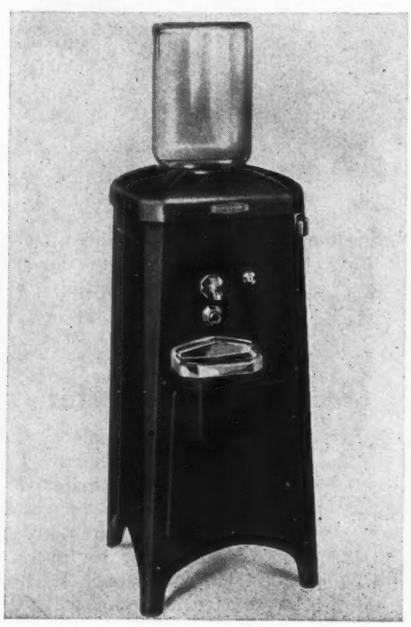
Westinghouse "Hypernik"

WESTINGHOUSE Electric & Manufacturing Company, East Pittsburgh, Pa., announces the development of a refined nickel-iron alloy of high permeability, known as "Hypernik." Among the many possible applications is its use in the construction of transformer cores, radio receivers, and sound amplifying systems.

■

Frigidaire Electric Water Coolers

FIVE models of electric water coolers have been announced by the Frigidaire Corporation, Dayton, Ohio. Sizes range from individual units to those of sufficient capacity to satisfy the requirements of a small industrial plant. Coolers are equipped with porcelain-lined food and beverage compartments and are finished in metallic lacquer with chrome-plated hardware. Either bottled or city water may be used.



Erie Hook-On Bucket

ERIE Steel Construction Company, Erie, Pa., announces the development of a hook-on or single-line clamshell bucket. The bucket is made available for work on cranes by placing the bucket yoke on the crane hook. The closing line is reeved around snubber sheaves. When the bucket is fully open, the power arm comes to rest against bumper springs, which act in combination with the rope reeving to open the bucket. Lips are of high-carbon steel

and extend to the top of the sheaves, where they tie in with the hinges. Moving parts are bronze bushed and lubricated by the Alemite system.

■

Lukens Nickel-Clad Steel Plate

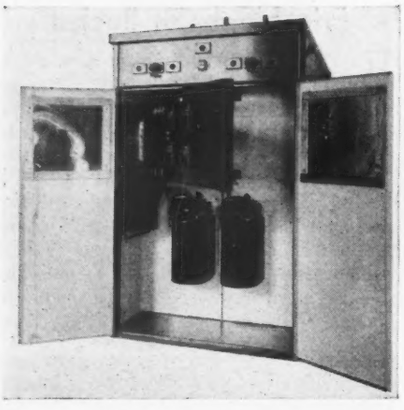
LUKENS Steel Company, Coatesville, Pa., with the cooperation of the International Steel Company, has developed a hot-rolled bi-metal of nickel and steel which is being marketed under the trade name, "Lukens Nickel-Clad Steel Plate."

One surface of the plate is completely clad with nickel during the rolling. The percentage of nickel can be furnished in various grades from 10 to 20 per cent of the total plate thickness. The product provides the corrosion resistance and other advantages of pure nickel in combination with structural strength said to be greater than ordinary steel plate.

■

General Electric Outdoor Switch Houses

OUTDOOR switch houses of either double- or single-circuit design have been announced by the General Electric Company, Schenectady, N. Y. In the single-circuit unit, space is provided for the future addition of a second circuit. The outgoing cable connects at the side of the house, while the



double-circuit connections are made through roof entrance bushings.

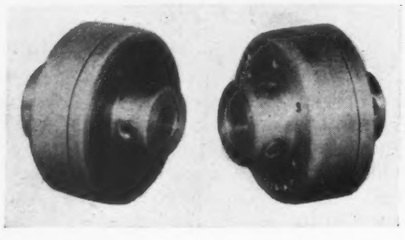
In the double-circuit arrangement, power enters through three center bushings and is supplied to feeder circuits through oil circuit breakers. Relays and instruments are mounted on a steel panel hinged and arranged to swing outward to an angle of 90 deg. with the front of the house, allowing access to the wiring in the back of the panel.

Doors are fitted with shatter-proof glass windows. Under normal conditions, the doors are closed and operation of the two circuits is effected by means of small control switches mounted just above the doors. Indicating lamps show the position of the breakers, and a lamp in the center indicates whether the incoming power line is alive. Just below this lamp, a plug connection is provided for attaching a lead for a drop light or other small power consuming device.

■

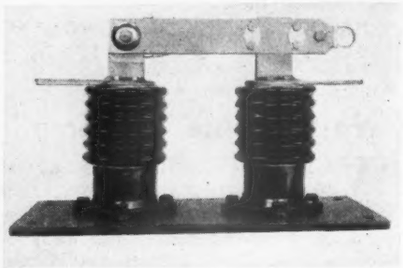
Crocker-Wheeler Flexible Couplings

CROCKER-WHEELER Electric Manufacturing Company, Ampere, N. J., announces a line of flexible couplings that depend upon the resilience of six rubber balls for their flexibility. As the torque to be transmitted varies, the lugs on the spider half squeeze the balls which are held in the flange half by cylindrical pockets. Balls are in compression in either direction of shaft rotation. Removal of the cover permits the balls to be taken out for inspection or replacement. With the balls removed, the driving mechanism is disconnected from the load. Couplings require no lubrication.



Champion Disconnecting Switch

CHAMPION Switch Company, Kenova, W. Va., has developed a 15-kv., 600-amp., disconnecting switch with a positive lock in the closed position and a 90-deg. friction stop which also will permit the blade to be opened to the full 180 deg. The stop feature on the locking ring is said to prevent the locking parts from receiving any of the stress required to open or close the blade. The

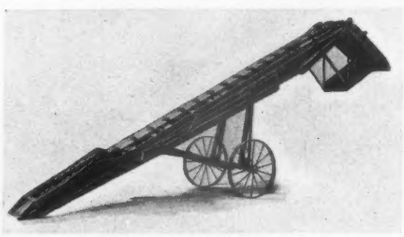


friction stop is carried between the double blades and backed by bronze springs. The tongue-type switch clips are of drop-forged copper and the double blades are the full-floating type.

■

Link-Belt Redesigns "Cub" Loader

LINK-BELT Company, Philadelphia, Pa., announces that its portable loader, known as the "Cub," has been redesigned. Added features include: 100 lb. less weight; metal troughing idlers with roller bearings; bronze-bushed shaft bearings; ball-bearing motor; Alemite lubrication; crank-operated, self-locking raising and lowering device; and roller-bearing equipped wheels.



■

Mathews Ball Transfer

ANNOUNCEMENT is made by the Mathews Conveyor Company, Elwood City, Pa., of a ball transfer designed for use in applications in which it is desired to obtain any direction of travel in a horizontal plane for objects having smooth, hard surfaces. It consists of a large, hardened, steel ball that

rotates on a number of smaller balls held in a cupped base. A dust cap rests on the ball, being held in position by a spring retainer.

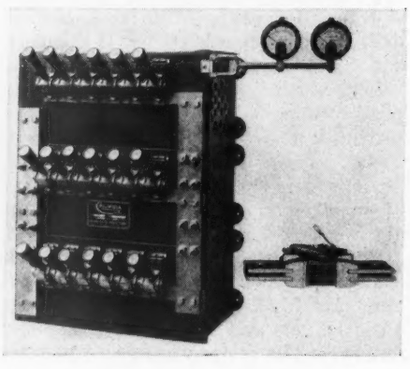
Units are available in two sizes. The 200-lb. capacity units have a 1½-in. ball supported by 105 balls $\frac{3}{16}$ in. in diameter. The 500-lb. capacity units have a 2-in. ball supported by 65 balls $\frac{5}{16}$ in. in diameter. The smaller size may be furnished with round or square bases for mounting on flat supports, or a threaded coupling base for mounting on 2-in. pipe supports. The larger unit is equipped with a threaded coupling base for mounting on 2-in. pipe supports.

■

Columbia Tank Rheostat

TANK rheostats with cast grid resistors and cam-action toggle switches have been announced by the Columbia Electric Manufacturing Company, 1292 East 53rd St., Cleveland, Ohio. Although especially designed for chromium plating, the instruments may be used in other applications requiring a wide range of tank voltage control.

The cast grids are mounted in the rear of the panel on three mica-insulated tierods, which are suspended and insulated from the ventilated end plates. The operating panel is of ebonite board, on which is mounted the contactor mechanism. The mechanism consists of renewable current-carrying contact



studs and contact fingers which are brought into the circuit by raising the cam-action toggles. This action locks the contact fingers against the contact studs. A pull on the toggle releases the mechanical pressure and breaks the circuit. Each contactor controls one section of resistance which may be introduced into the circuit as required.

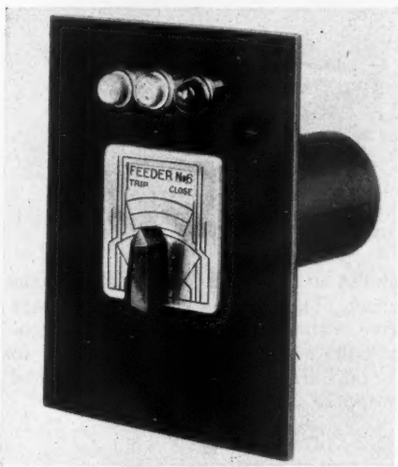
Rheostats are available in standard sizes up to 10,000-amp. capacity. Ammeter and voltmeter are furnished as optional equipment.

■

Westinghouse "Minatrol"

"MINATROL" is the trade name of a miniature control switch developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It is designed for such uses as circuit-breaker control, speed and voltage control, and synchronizing.

The overall panel space requirements

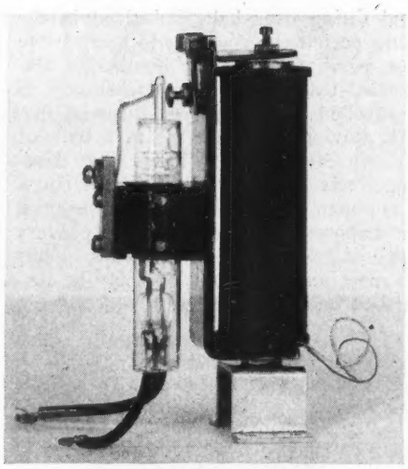


of 4 x 3¼ in. include the miniature lamps known as "Minalites," and the space required for turning the handle and making connections. Wiring is arranged to eliminate the necessity for auxiliary batteries and relays and to include bell alarm and signal circuits. The front plate is composed of corrosion-resisting steel. Lamps are of a self-contained molded unit assembly with resistors for use on full-voltage control circuits of 125 or 250 volts.

■

Burgess Vacuum Contact

BURGESS Battery Company, 295 Madison Ave., New York, N. Y., announces the development of a vacuum contact designed for applications in which considerable wattage must be controlled by a minimum of energy. It can be operated manually, mechanically, or electromagnetically. The principle

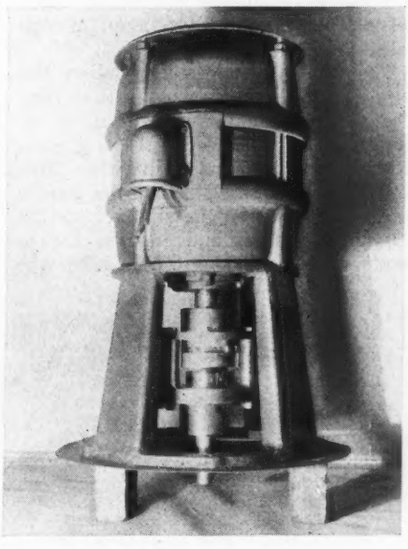


upon which the instrument operates is that, because of the elasticity of the glass bellows which support the glass rod actuating the contact, a slight pressure on the rod separates the contact members. The contact is rated to handle 6 amp. at 220 volts on continuous load and 8 amp. at 220 volts intermittently on either d.c. or a.c. circuits. The illustration shows a vacuum contact mounted on a telephone relay.

■

Ideal Vertical Pump Couplings

VERTICAL couplings for deep-well turbine pumps have been developed by The Ideal Electric and Manufacturing Company, Mansfield, Ohio. They are said to eliminate the necessity for using special hollow-shaft motors and to remove the dangers of backspin. The necessary adjustment to obtain proper clearance for the turbine pump rotor is provided in the coupling. The motor may be removed from the drive by raising it high enough to clear the coupling and

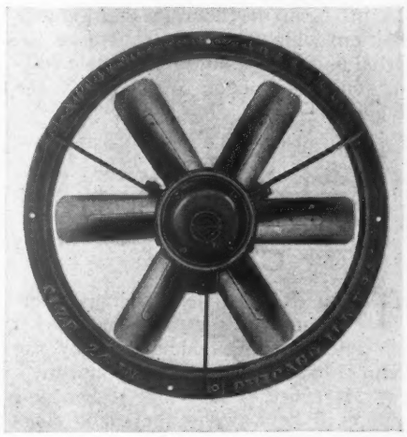


base. Couplings are designed to disengage the motor from the pump when backspin occurs, the lengthening shaft acting on drive pins in the coupling. Two types of couplings are available, one with the backspin release, and one without this feature. The latter type provides for thrust in both up and down directions.

■

Autovent Fans

AUTOVENT Fan & Blower Company, 1805 North Kostner Ave., Chicago, Ill., announces a line of non-overloading propeller fans known as the 31 Series. Motors may be furnished for either d.c. or a.c. operation. Bearings are wool packed. Design of the fan wheels is said to be such that they will



not overload the motor regardless of the amount of restriction. Seven sizes, ranging from 12 to 36 in., comprise the line.

■

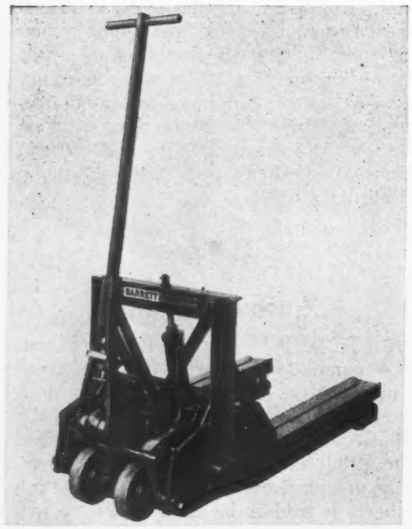
Weston Electrical Instrument Corporation Acquires Jewell Electrical Instrument Company

ANNOUNCEMENT is made by the Weston Electrical Instrument Corporation, Newark, N. J., that it has acquired the Jewell Electrical Instrument Company, Chicago, Ill. The purchased company will be operated as a subsidiary, retaining its name and substantially the same personnel.

■

Barrett-Cravens Lift Truck

BARRETT-CRAVENS Company, 101 West 87th St., Chicago, Ill., announces a fork-type lift truck designed for handling tin plate. Forks are

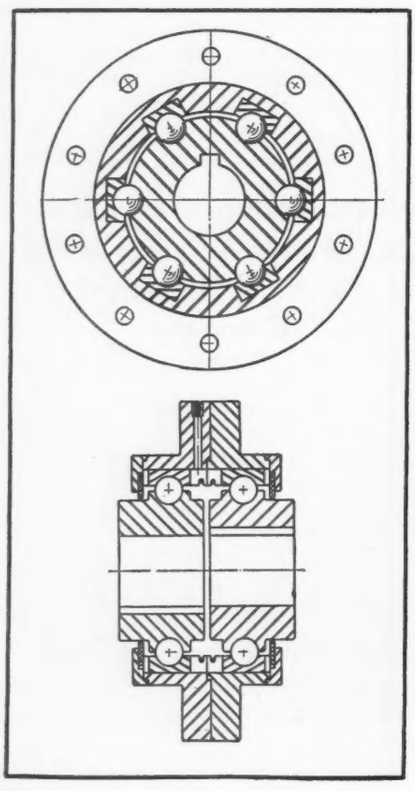


3½ in. from the floor in their lowest position, which enables them to be inserted underneath piles of tin plate resting on 2x4's, upon which they are shipped.

■

Penn "Davis" Flexible Couplings

"DAVIS" flexible couplings operating on the ball and socket principle have been announced by the Penn Machine Company, Johnstown, Pa. Hardened and ground socket keys sliding in keyways in the outer rings and fitting over balls imbedded in the hubs permit the coupling to compensate for misalignment. The number of imbedded balls and sliding socket keys is controlled by the size of the coupling. All moving parts operate in a bath of oil, which is sealed by brass rings floating freely in grooves in the outer rings. Couplings are available with shrouded or exposed bolts for practically every type of drive and load condition. Units to meet unusual conditions may be furnished on special order.

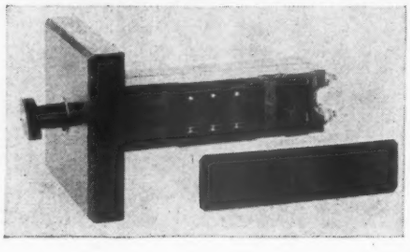


■

General Electric Miniature Control Switch

GENERAL Electric Company, Schenectady, N. Y., announces a control switch for miniature switchboards. It consists of an operating shaft which actuates a set of single-pole, double-throw, main contacts, and two sets of three, single-pole, single-throw, auxiliary contacts. The contacts are mounted within a textolite frame, the cover of which can be removed to permit inspection. The main contacts have a continuous rating of 10 amp. at 600 volts, and the auxiliary contacts 5 amp. at 600 volts.

The switch is operated by pulling the handle slightly and turning it 45 deg. clockwise to the close position, or 45 deg. counter-clockwise to the trip position. The main contacts in either position are closed by pushing the handle inward. A cam on the shaft closes the auxiliary contacts and engages a projection in the housing which holds the handle in the 45-deg. position and one set of the auxiliary contacts closed. When the handle is released, the main contacts are opened by the action of a spring but the auxiliary contacts remain closed.



■

Blackhawk Wrench Set

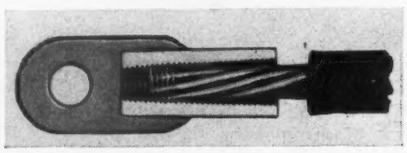
BLACKHAWK Manufacturing Company, 120 North Broadway, Milwaukee, Wis., announces the 12-ED wrench set, designed for extra heavy-duty requirements, such as are found in heavy machinery assembly and plant maintenance work.

Wrenches are chromium plated with double-hexagon sockets and the "Lock-on" drive with pushbutton release. The last feature enables the sockets to be locked to the extensions and other handles and released by pressing a pushbutton. The set has the ⅞-in., square drive with sockets suitable for hexagonal bolts and nuts ranging from 1¼ to 2⅜ in. Larger sockets may be furnished on special order.

■

Ideal "Thread Lugs"

IDEAL Commutator Dresser Company, Sycamore, Ill., announces wire threading terminals known as "Thread Lugs." The hole in the bronze shank is tapered and threaded with a full V thread. As the lugs are screwed onto the bared wire, threads are formed in the wire, the bronze shank acting as a die on the softer copper. In making the connection, the web of the lug may be grasped with a wrench or pliers while the wire is held by hand, a short kink in the wire facilitating a firm grip. Lugs are available in four sizes for Nos. 0-, 2-, 4-, and 6-gage solid wire. Each lug size will accommodate several wire sizes.



TRADE LITERATURE

For copies, address the manufacturers concerned

■

(224) SCREWS — Booklet, 12 pages, hardened, self-tapping screws. — Parker-Kalon Corporation, Dept. N, 200 Varick St., New York, N. Y.

(225) MAGNETS—Bulletin 910, 8 pages, separator magnets for removing tramp iron from conveyors.—The Electric Controller & Manufacturing Company, Cleveland, Ohio.

(226) STANDARDS—Sixth edition of the Standards of The Hydraulic Society, 96 pages.—The Hydraulic Society, 90 West St., New York, N. Y.

(227) INSULATION — Folder, "How to Deaden Machine Vibrations and Noise" by means of natural cork.—L. Mundet & Son, 461 Eighth Ave., New York, N.Y.

(228) MOTORS — Bulletin 500-A, 16 pages, multi-speed, squirrel-cage a.c. motors.—The Louis Allis Company, Milwaukee, Wis.

(229) CONTROL EQUIPMENT — Bulletin 1105, 8 pages, standard, vapor-proof, and explosion-proof push buttons.—The Electric Controller & Manufacturing Company, Cleveland, Ohio.

(230) POWER TRANSMISSION—Bulletin 212, 14 pages, ball and roller bearing pillow blocks and shaft hangers.—SKF Industries, Inc., 40 E. 34th St., New York, N. Y.

(231) COAL BURNER—Bulletin 905, 4 pages, circular burner for pulverized coal. —Fuller Lehigh Company, 85 Liberty St., New York, N. Y.

(232) CONTROL—Folder, 4 pages, photo-electric amplifier relay control.—General Amplifier Company, 27 Commercial Ave., Cambridge, Mass.

(233) HEATING UNITS—Leaflet TA-30, 4 pages, electric heating elements and units.—Harold E. Trent Company, 618 N. 54th St., Philadelphia, Pa.

(234) MOTORS—Leaflet 20385-A, Type CS squirrel-cage induction motors with interchangeable mechanical and electrical parts.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(235) POWER TRANSMISSION — Catalog 136, 96 pages, continuous-tooth herringbone speed reducers and gears.—D. O. James Manufacturing Company, 1120 W. Monroe St., Chicago, Ill.

(236) FLOATS—Bulletin 43, 4 pages, "Nicholson" welded steel floats.—W. H. Nicholson & Company, 12 Oregon St., Wilkes-Barre, Pa.

(237) POWER TRANSMISSION—Catalog, 84 pages, formulas for V-belt calculations, tables of drives and chart for center distances.—L. H. Gilmer Company, Tacony, Philadelphia, Pa.

(238) MOTORS—Bulletin 165, 7 types of squirrel-cage motors.—Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

(239) CHAIN—Bulletin, "weldless" coil chain and attachments.—American Chain Company, Inc., Bridgeport, Conn.

(240) TIME RECORDER—Circular 1524, 4 pages, "The Strowger Multiple Time-Recorder" for watchmen's reports and industrial service. — Automatic Electric Inc., 1033 W. Van Buren St., Chicago, Ill.

(241) CONTROL—Bulletin 1062, 8 pages, Type ZHS, 2,300-volt magnetic contactors for a.c. motors.—The Electric Controller & Manufacturing Company, Cleveland, Ohio.

(242) VULCANIZED FIBER — Pamphlet, standard dimensions, tolerances, and specifications for vulcanized fiber sheets, tubes, rods, and rolls.—National Electrical Manufacturers Association, 420 Lexington Ave., New York, N. Y.

(243) PAINT—Bulletin, 12 pages, "Barreled Sunlight" paint in industrial plants. —U. S. Gutta Percha Paint Company, 19 Dudley St., Providence, R. I.

(244) POWER FILTER — Bulletin, power filter units for converting alternating current into direct current.—Square D Company, 6060 Rivard St., Detroit, Mich.

(245) MATERIALS HANDLING — Book 1217, fuller's earth conveyors for oil refineries. — Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill.

(246) HEATERS — Bulletin 3-B, Hynes Type M multi-vane fan circulation electric heaters.—Hynes Electric Heating Company, 240 Cherry St., Philadelphia, Pa.

(247) MATERIALS HANDLING — Booklet "Belt Practice," practical features of design and maintenance of conveyor and elevator belts.—The Diamond Rubber Company, Inc., Akron, Ohio.

(248) PUMPS—Specification W-112-S12, 4 pages, horizontal duplex, block-valve type piston pumps.—Worthington Pump & Machinery Corporation, Harrison, N. J.

(249) CRANE CONTROL—Folder, 4 pages, dynamic-braking bridge-stop control.—The Electric Controller & Manufacturing Company, Cleveland, Ohio.

(250) HEATERS — Bulletin 101, Type IDL gas-fired heater; Bulletin 201, Type L indirect—gas-fired air heater.—Drying Systems, Inc., 1800 Foster Ave., Chicago, Ill.

(251) CONTROL EQUIPMENT — Catalog 1101, construction features of the Brown potentionmeter pyrometer. — The Brown Instrument Company, Wayne and Roberts Ave., Philadelphia, Pa.

(252) POWER TRANSMISSION — Catalog 1002, 62 pages, design and construction details of V-belt drives.—L. H. Gilmer Company, Tacony, Philadelphia, Pa.

(253) LIGHTNING ARRESTERS—Circular 1737-F, 24 pages, "Advance Guards," autovalve arresters.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(254) AIR CONDITIONING—Catalog 383, 8 pages, "Humidifilter," an air-conditioning unit.—B. F. Sturtevant Company, Hyde Park, Boston, Mass.

(255) CONTROL EQUIPMENT—Architects' and Engineers' Bulletin 293, 18 pages, Type DF-30 "Saftoswitch-boards."—Bull Dog Electric Products Company, Detroit, Mich.

(256) POWER TRANSMISSION—"Ball and Roller Bearings"—A handbook for designers and engineers, 68 pages.—Aetna Ball Bearing Manufacturing Company. 4600 Schubert Ave., Chicago, Ill.

(257) ARC WELDING — Leaflet L-20518, Flex-arc, 600-amp. single-operator welder for pipe lines.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(258) POWER TRANSMISSION — Bulletin 81, 12 pages, the Robins-Jones bearing.—Robins Conveying Belt Company, 15 Park Row, New York, N. Y.

(259) ARC WELDING—Arc-welding data, Bulletin 15, 16 pages.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(260) SHOCK ABSORBER—Bulletin 2, improved pulsation shock absorber for pressure gages.—The Meriam Company, 1955 W. 112th St., Cleveland, Ohio.

(261) LOCKNUT — Folder, "Marsden" one-piece locknut. — American Marsden Company, 1 Exchange Place, Jersey City, N. J.

(262) ELECTRIC HEATING—Bulletin 260, 8 pages, "Falcon" continuous electric furnaces for heat-treating strip metal and wire.—H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa.

COMING EVENTS

American Institute of Electrical Engineers—Annual Pacific Coast Meeting, Lake Tahoe, Calif., Aug. 25 to 28. Secretary, F. L. Hutchinson, 33 West 39th St., New York, N. Y.

American Welding Society—Fall Meeting and Exposition, Boston, Mass., Sept. 21 to 25, Secretary, A. V. Hutchinson, 51 Madison Ave., New York, N. Y.

National Metal Congress and Exposition—Exposition, Commonwealth Pier, and Congress sessions, Hotel Statler, Boston, Mass., Sept. 21 to 26. W. H. Eisenman, Secretary, A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

National Safety Council—20th Annual Safety Congress, Chicago, Ill., Oct. 12 to 16. Headquarters, Civic Opera Building, Chicago, Ill.

Illuminating Engineering Society — Annual Convention, Hotel William Penn, Pittsburgh, Pa., Oct. 13 to 16. Assistant Secretary, Frank G. Horton, 29 West 39th St., New York, N. Y.

MAINTENANCE ENGINEERING

L. C. MORROW, Editor

JULY, 1931

Net Profit via Modernization

EVERY worth-while plant always is trying to increase its net profit—to widen the spread between gross receipts and operating expenses.

In times of prosperity the greater net profit well may be distributed as extra dividends, or added to surplus, or used in both ways.

In times of depression it is most likely to be used to increase competitive ability. Certainly it makes possible increased sales effort and lowered selling prices, even though wage and salary levels are maintained.

And how increase net profit? By making use of available modern equipment and modern methods, both applied with appropriate quantities of common sense. The term "modernization" may not be the inspiration that it once was, because of familiarity with it. The advice itself may bear the stigma of much repetition.

Both are just as sound as ever, nevertheless. The policy of making things at the lowest possible unit cost is safe and sane as always. Witness the accomplishments of Champion, Ryerson, and Inland Steel, as recorded in this issue. These three concerns are leaders, and their indorsement of modernization is obvious.

If it happens that your ideas aren't quickened, your vision widened, your conception sharpened by the term "modernization," try looking ahead in terms of its synonym, "net profits."

Tune Up the Man, Too, in Modernizing

AS THE maintenance engineering job grows, bigger men are required to fill it. Managers who hire maintenance engineers must give heed to this fact. It's in the cards that uninterrupted production, low product costs, and net profits are to be influenced more and more by efficient, economical maintenance.

Maintenance engineers are spending increasing percentages of their companies' money. When they are not actually signing on the dotted line they are being responsible for the specifications that are written in above the signature.

Time was when almost any man who possessed the knack of keeping things hitched together was intrusted with the plant's valuable property. The amount of freedom to tinker with expensive equipment that was allowed him is appalling. That time is no more in the plant that really is modern. Instead, a man of ability has the job and is paid a salary commensurate with the trust.

There is a right type of maintenance engineer. He is the kind of man who knows equipment. But he is also the kind of man who is capable of setting up maintenance budgets and of keeping expenditures within them; of instituting and abiding by systematic procedure; and of instilling in the personnel of his department devotion to the function and the plant that they serve.

For the plant not really modern (and there are many) there exists the attractive opportunity to begin its modernization program by modernizing personnel. The head of the management rather than the maintenance function will take the first step by hiring the right maintenance engineer. When this man gets on the job he will modernize equipment and methods.

For the maintenance engineer who doesn't know just what this matter of the up-to-date plant is all about, there exists the opportunity to modernize himself. After he has brought himself up to date, perhaps he will be able to do much more on the job he now holds; or he may be one of the men who is going to get one of the bigger jobs in a revision of personnel. In either case he'll energetically keep himself informed as to the meaning and development of the maintenance function; the methods that the leaders in maintenance are following; and the equipment available by which to bring about more efficient operation of his plant.

Report Back on Equipment Failures

"YOUR equipment is satisfactory in every way," is the message that the manufacturer likes most to hear. It's a good thing for the user to make that report when he can; the manufacturer is inspired to even greater accomplishment.

Next, the equipment maker should be interested in hearing, "Here's how your equipment failed, and here's why." Unusual, indeed, is the piece of equipment that is perfect under all conditions.

Designed for a specific service, equipment may function exactly as planned. Adapted for other service it may fail. The manufacturer, though not at fault, may lose by failing to secure repeat orders. But the user also loses, because of the cost of equipment shutdown and repair or replacement expense.

Obviously the user is best serving himself if he will report back to the manufacturer the facts of failure and the service conditions under which failure occurred.